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The *Blue Dolphin* at anchor in Seaplane Cove, northern Labrador. This was the base of the Grenfell-Forbes Expedition of 1931.

THE *BLUE DOLPHIN* LABRADOR EXPEDITIONS, 1949 and 1950

By David C. Nutt*

DURING the summers of 1949 and 1950 a party of scientists in the *Blue Dolphin*, a schooner of fisherman-type construction, carried out oceanographic and biological research along the coast of the Labrador. The general specifications of the schooner, which was acquired in 1948, were as follows:

Length over-all	100 ft.
Beam	22 ft.
Draft	12 ft.
Registered gross tonnage	91
Engine	140 H.P. Wolverine Diesel
Cruising speed	7 knots
Maximum speed	8 knots
Year built	1926
Place of origin	Shelburne, N.S.
Designer	W. J. Roue

In fitting the vessel for northern research work, certain alterations were necessary: the fuel capacity was increased to give a cruising range of 4,000 miles; accommodation was refitted to give berthing and messing facilities for a total party of eighteen to twenty; the bowsprit and main boom were cut down for ice navigation with proportionate reduction of the sail area; and the electrical plant was refitted to provide 110 volts (D.C. or A.C.) for operating equipment and scientific instruments.

With the cooperation of the U.S. Office of Naval Research, the U.S. Coast and Geodetic Survey, the Smithsonian Institution, the Woods Hole Oceanographic Institution, and Dartmouth College, the following principal items of scientific and navigational equipment were acquired:

1 Type NJ/9 recording fathometer
1 Type NK/7 portable recording fathometer
1 Bathythermograph winch, boom and gear
1 Hydrographic winch (with capacity for 2,000 metres of 5/32-inch wire) and gallows frame
Trawling gear
Phleger core sampler
Clarke-Bumpus plankton sampler
Radio receiving and transmitting equipment
Navigational loran
Mark VII binnacle with magnetic compass
Oceanographic and biological laboratory
Portable recording gauge

The *Blue Dolphin* expeditions have been supported by the Arctic Institute, with funds provided by the U.S. Government, the Canadian Government (1949), and private sources. The scientific program is carried out in cooperation with government and private organizations,

*Dartmouth College Museum.

such as the Smithsonian Institution, Canadian Geographical Bureau, Woods Hole Oceanographic Institution, Dartmouth College, and Cornell University. The members of the ship's company in 1949 and 1950 are listed on page 11.

The investigations of the past two years have been devoted to a general study of the coastal waters of the Labrador, which oceanographically and economically form an important part of Eastern Canadian Arctic waters. The latter are generally considered to be bounded on the west by the western shore of Hudson Bay, on the east by the west coast of Greenland, on the north by the Lincoln Sea, and on the south by the Strait of Belle Isle. In this region the waters of west Greenland are best known; elsewhere, oceanographic knowledge is still very incomplete. Baffin Bay and the Labrador Sea were studied in detail for the first time between 1928 and 1935 by the U.S. Coast Guard and by Danish parties, and as a result of this work the Labrador Current was defined; in 1930 the Canadian Fisheries Expedition made some investigations in Hudson Bay; finally, between 1946 and 1949 Dr. M. J. Dunbar made a study of Ungava Bay and Hudson Strait. Much of this work now requires repetition owing to widespread and important oceanographic changes which appear to have been taking place. Moreover, a study of the physical conditions, productivity, and ecology of these waters is important because their resources are fundamental for the support of the native population and future development of the region.

Eastern Canadian Arctic waters form a series of circulations in Baffin Bay, the Labrador Sea, and Hudson Bay which are in turn part of the larger circulation of the North Atlantic Drift and the waters of the Arctic Ocean. The coastal waters of the Labrador in the southern part of this region are under the primary influence of the cold Labrador Current and its interaction with the waters of the Labrador Sea, the coastal drainage, and, in the Belle Isle area, with the Gulf of St. Lawrence water. For nearly six months of each year the Labrador Current carries southward large masses of ice which block the entire coast, and provide the whelping grounds for the seals hunted by the sealers. During the summer months, when the pack ice breaks up and moves south to melt, codfish are found in great numbers.

In order to obtain a more complete and detailed knowledge of the effect of the general circulation on local conditions along the Labrador, studies were carried out at various points between the Strait of Belle Isle and Seven Islands Bay. In 1949 St. Lewis Inlet, Kaipokok Bay, and Hebron Fiord were examined with a brief reconnaissance of Hamilton Inlet and Lake Melville. In 1950 work was centred on the Hamilton Inlet-Lake Melville area; but also included an examination of Seven Islands Bay. Figure 1 shows the principal areas studied.

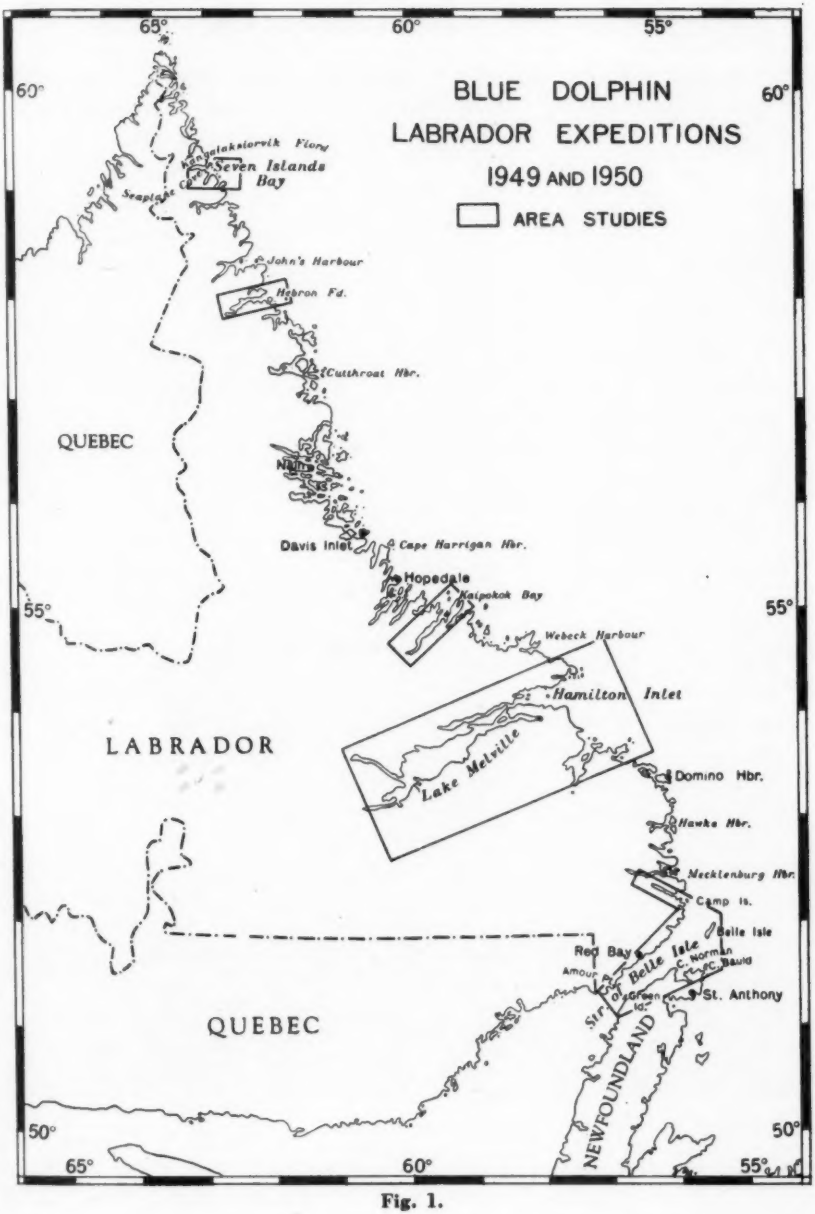


Fig. 1.

The work in short has consisted of a comprehensive ecological study of the coastal waters. In conjunction with the oceanographic observations, the following biological collections have been made: qualitative and quantitative plankton collections by means of Stramin nets and a Clarke-Bumpus plankton sampler; benthic faunal collections by means of trawls

L. Coachman attaching the Clarke-Bumpus plankton sampler. The low freeboard of the *Blue Dolphin* is a great asset in handling instruments and nets alongside.

and dredges, and fish collections from both salt and fresh water.

In addition to work in selected areas along the coast of the Labrador a study was also carried out in 1949 of the Strait of Belle Isle, where three oceanographic sections were made: Amour Point to Green Island, Red Bay to Cape Norman, and Camp Islands to Belle Isle to Cape Bauld.

The Hamilton Inlet-Lake Melville area investigated in 1950 will be described in some detail as this study forms one of the most important parts of the *Blue Dolphin* program. Hamilton Inlet has a very irregular bottom with shoals between 3 and 10 fathoms and general depths of between 20 and 40 fathoms. The inlet stretches inland from the coast in latitude 54°N. for some fifty miles to Rigolet, where the channel narrows to a width of one mile with depths of 14 to 15 fathoms on the "sill". Beyond this point, called The Narrows, lies Lake Melville, a tidal lake, which stretches eighty miles westwards, becoming nearly twenty miles wide at the western end, with depths of over 100 fathoms in the northeastern half. Goose Bay extends fifteen miles west of Lake Melville, the entrance being restricted by sand flats, with depths of one to two feet, and a channel less than half a mile

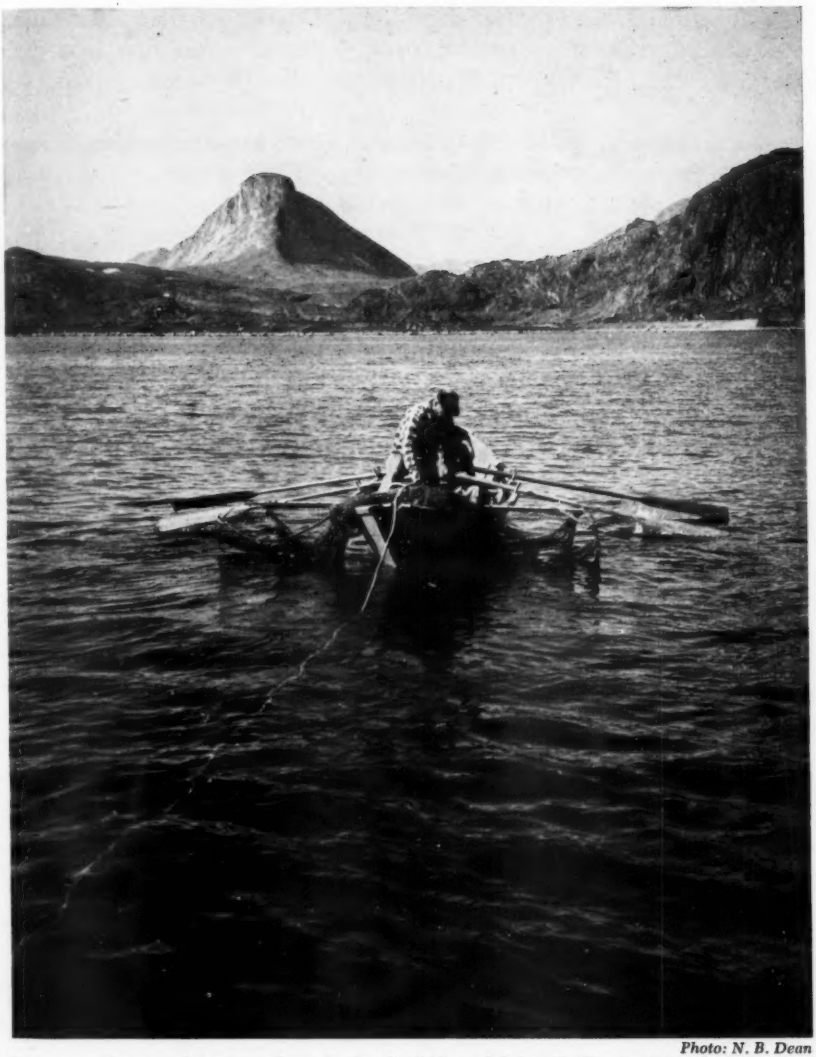


Photo: N. B. Dean

Dory carrying out beam trawl at the head of Kangalaksiorvik Fiord. This technique of taking the trawl off by dory or launch and hauling it back on board is used in waters where the vessel cannot be manoeuvred.

wide, with 21 feet on the "bar"; in Goose Bay itself depths increase again to 30 fathoms. Terrington Basin, an arm of Goose Bay, has depths of 10 to 12 fathoms, but is separated from Goose Bay by a 6-fathom channel, only fifty yards wide. The general picture is that of a series of basins separated at various points by constrictions and sills (*see* Figs. 2 and 3).

The major eastward drainage of the Ungava Peninsula into Goose Bay and the western part of Lake Melville flows through four main channels: the North West, Hamilton, Goose, and Kenamu rivers. Of

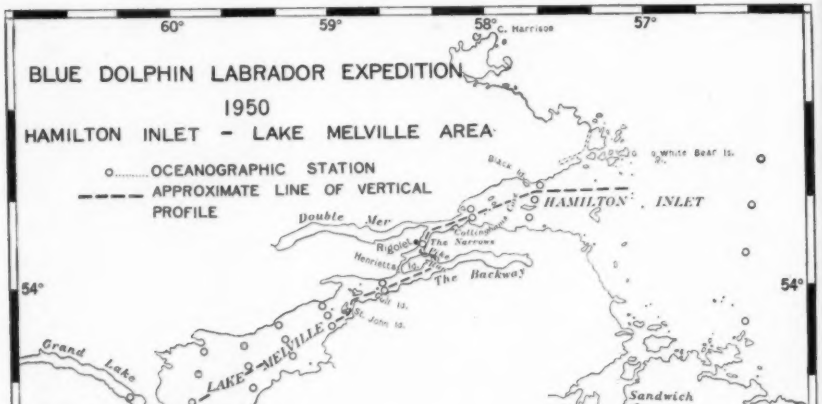


Fig. 2.

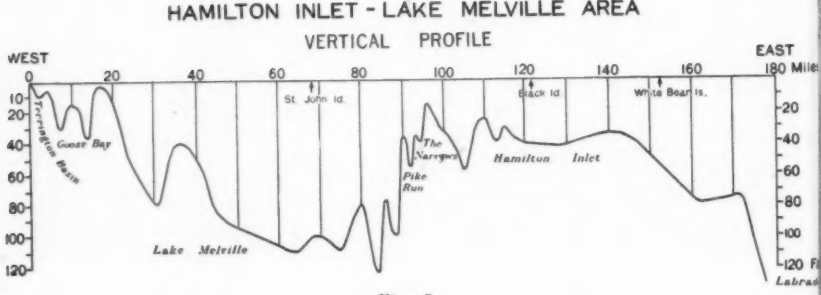


Fig. 3.

these the Hamilton is by far the largest both in the volume of water carried and in the extent of the area drained.

Four oceanographic stations made between 23 and 26 August 1949 and a series of bathythermograph observations give a general indication of some of the local conditions. At this period of the year the surface water of Goose Bay is practically fresh with a salinity of less than one

part per thousand, at a temperature of approximately 14°C. In the bottom layers, at depths from 20 to 40 metres, the temperature is less than 2°C with a salinity of 21.00-22.00 parts per thousand. In Lake Melville high surface temperatures prevail, ranging from 11.5° to 14.5°C, while surface salinity increases from about 3.00 parts off Epinette Point to about 10.00 parts per thousand to the west of St. John Island. The bottom layers of the lake present a marked contrast, with temperatures below 0°C and salinities of from 25.0 to 28.5 parts per thousand, the sharp transition taking place between the depths of 10 and 20 metres. On passing through The Narrows to Hamilton Inlet the change in the surface layers is abrupt. At a station off Black Island the surface temperature was found to have dropped to 4.9°C with a salinity of 26.50 parts per thousand, while near the bottom at 50 metres the temperature was about 2°C and salinity 31.76 parts per thousand.

Thus the surface waters of Goose Bay and the western part of Lake Melville are under the dominant influence of the great land drainage. There is, however, a definite exchange and intrusion of the more saline coastal water of Hamilton Inlet into Lake Melville and even across the 21-foot bar into Goose Bay, where it appears concentrated in dense bottom layers. The principal exchange and mixing of the waters occurs in The Narrows, with a net overflow due to the discharge of fresh water from the land drainage into Lake Melville.

In spite of the great inflow of fresh water over the surface layers of Lake Melville the fauna is predominantly marine, but both invertebrates and vertebrates are scarce. In contrast visual observations and year-round reports suggest that the waters of The Narrows, where the principal mixing takes place, are very productive. This is also indicated by the abundance in this area of the higher forms in the food chain, such as whales and seals. Immediately to seaward of The Narrows, where the influence of the coastal water becomes dominant, great numbers of codfish were noted, particularly in Collingham's Cove, where the *Blue Dolphin* occasionally anchored.

In 1950 twenty-seven oceanographic stations were established in the area: one in each of Goose Bay, Terrington Basin, and Grand Lake, fourteen in Lake Melville, one in The Narrows, and nine in Hamilton Inlet. The locations of the stations are shown in Fig. 2. The detailed observations made are still being worked up and cannot be included in this paper.

The Narrows station was perhaps the most interesting, being located on the sill between Hamilton Inlet and Lake Melville where the principal exchange of water occurs. The station was occupied continuously throughout one complete tidal cycle, during which hourly bathythermo-

graph and Nansen bottle observations were made. Position was taken at 0530 hours on 24 July 1950 at slack water. Hourly observations were begun at 0600 hours. Ebb current ran for nearly 8½ hours, slack water occurring again at approximately 1400 hours. A maximum ebb current of 5 knots occurred at 1015 hours approximately 50 minutes after low water Rigolet. The flood tide then ran from 1400 to a little after 2015 hours, a maximum of 4 knots occurring at 1645 hours, 80 minutes after high water Rigolet. The complete tidal cycle thus involved nearly 15 hours, even though high and low water as determined by tide staff reading at Rigolet occurred within 10 minutes of the predicted times. Unfortunately time did not allow us to continue the station long enough to determine how this departure from the normal twelve-hour cycle may be compensated. It is apparent that the exchange of mechanism of The Narrows, with a possible circulation around Henrietta Island, is complicated. It is hoped that the data obtained in 1950 may throw light on the problems of this interesting estuary.

While travelling coastwise in the poorly charted waters north of Hamilton Inlet reconnaissance sounding tracks were made on various inside runs, together with such navigational notes and recommended revisions of the sailing directions as were possible.

In addition to the main program of oceanographic and marine biological investigations certain additional projects have been undertaken. In 1949 transport and support were given to Mr. Elmer Harp, Jr. and his assistant, who spent the summer in the Strait of Belle Isle area doing archaeological work, and a party of geographers, led by Mr. W. A. Black of the Canadian Geographical Bureau, accompanied the *Blue Dolphin*. In 1950 Mr. Charles Handley, Jr. of the Smithsonian Institution made small mammal and bird collections, while Mr. James Schwedland of Yale University studied certain aspects of forest botany.

These additional projects fitted in well with the work of the expedition. It has been found that under almost all conditions except the most violent of storms some work can be done; at no time is the vessel laid up with all hands idle. During the voyages various field projects were carried out almost daily. An effort was made to reach an anchorage in time to allow traps to be set before dark and shore and hydrobiological collections to be made of birds, mammals, fish, marine invertebrates, insects, and botanical material. Shore parties were left at base camps for periods of from two days to two weeks for intensive examination of an area, while the vessel was operating in the vicinity.

The studies of the bird and mammal population in this easternmost section of the North American continent proved particularly interesting. For instance the large series of *Peromyscus maniculatus maniculatus*, the

white-footed mouse, obtained in 1950, much of which is topotypical, will make it possible to define that race properly for the first time since it was established on very few specimens.

In conclusion, the two summers' operations have shown that the *Blue Dolphin* is well suited and equipped for the type of work, which it is planned will be continued during the summer of 1951.

Members of the "Blue Dolphin" Expeditions

Scientists	1949	
Richard H. Backus	Cornell University	Oceanographer and Biologist
Gifford Beaton	Canadian Geographical Bureau	Geographer
William A. Black	Canadian Geographical Bureau	Geographer
Paul C. Cabot, Jr.	Harvard University	Student assistant
Nicholas B. Dean	St. Paul's School	Student assistant
Elmer Harp, Jr.	Dartmouth College	Archaeologist
Arthur W. Herrington, Jr.	Massachusetts Institute of Technology	Student assistant
Neil MacArthur	Canadian Geographical Bureau	Geographer
Henry P. McKean, Jr.	Dartmouth College	Oceanographer
Stearns A. Morse	Dartmouth College	Assistant Archaeologist
David C. Nutt	Dartmouth College	Master and Leader
Frederick A. Stahl	Dartmouth College	Student assistant
Anthony F. Susen	Children's Hospital, Boston, Mass.	Surgeon
Professional Crew		
Otto Halvorsen	Drammen, Norway	Boatswain
Ralph A. Haskell	Essex, Mass.	Seaman
Rowland Pearson	New Bedford, Mass.	Cook
Percy L. Poirier	Ipswich, Mass.	Seaman
Marcus Sigurjonsson	Reykjavik, Iceland	Seaman
Charles D. Spohr	Centerville, Mass.	Chief Engineer
Reginald Wilcox	Hartford, Conn.	Special assistant
Scientists	1950	
Richard H. Backus	Cornell University	Oceanographer and Biologist
Lawrence Coachman	Yale University	Assistant Hydrographer
William Butler	Johns Hopkins University	Student assistant
Jack Dailey	Dartmouth College	Communications
Nicholas B. Dean	Dartmouth College	Student assistant
Charles C. Hall	Mary Hitchcock Memorial Hospital	Surgeon and Zoologist
Charles O. Handley, Jr.	Smithsonian Institution	Zoologist
Emerson Hibbard	Cornell University	Assistant Biologist
David C. Nutt	Dartmouth College	Master and Leader
Mary L. Nutt	Hanover, N.H.	Secretary
James Schwedland	Yale University	Forest Botanist
Otto Schumacher	Dartmouth Medical School	Oceanographic Chemist
William Stubbs	Dartmouth College	Student assistant
Garry Valentine	Yale University	Student assistant
Professional Crew		
Otto Halvorsen	Drammen, Norway	Boatswain
Henry P. Holmes	Waquoit, Mass.	Chief Engineer
Marcus Sigurjonsson	Reykjavik, Iceland	Seaman
Norman Turcotte	Tiverton, R.I.	Steward
Reginald Wilcox	Hartford, Conn.	Special assistant

Photo: C. Vibe

Fishing vessels at Julianehaab.

PLANNED REFORMS IN GREENLAND

By Finn Nielsen*

DURING the greater part of the present period of colonization, which dates back to 1721, the economic structure of the Greenland community has been based mainly on production for subsistence. Sealing, which yielded the necessary food and clothing, was the only occupation of any importance and, sheltered by the Danish protective colonial system (in particular by a ban on the free entry into the country and a Government trading monopoly), the Greenland population led a life which was, indeed, primitive but no doubt a happy one in many respects.

As is well-known climatic changes have occurred all over the world since the 1920's. In Greenland the climate is becoming constantly milder with the result that the abundance of seal known in former days has almost disappeared. The seal have drawn north, away from the inhabited regions, and in their stead great quantities of codfish have appeared in the waters

*Greenland Department.

round Greenland. This change in the fauna and the consequent change in the pursuits of the Greenlanders have brought about a great upheaval in the life of the Greenland community. To the Greenlander the transition from sealing to fishing meant that the free, primitive life had to be abandoned and that he had to adjust himself to an entirely different mode of existence. The economic cooperation and collaboration of modern communities now became necessary in Greenland.

This development had been followed with close interest in Denmark. In the summer of 1948 Mr. Hans Hedtoft, then Prime Minister, visited Greenland at the request of Mr. Eske Brun, then Inspector in Greenland (now Permanent Under-Secretary of State), in order to get a clear understanding of the wishes of the Greenland population through talks with the two Provincial Councils.

Three main wishes were voiced by the Councils:

1) that the existing ban on the free entry into the country be repealed,
2) that the Danish Government trading monopoly be abolished and replaced by a more flexible system admitting Danish private enterprise to trade in Greenland, subject, however, to a certain measure of Government control,
3) that the diversified state of law for Danes and Greenlanders be abolished and replaced by a common judicial system.

On his return home the Prime Minister, in conformity with a wish expressed by the Greenland Provincial Councils, appointed a Greenland Commission, on which the Greenland Provincial Councils were also represented. Under the chairmanship of Mr. H. H. Koch, Permanent Under-Secretary of State, the Commissioners started work in the last week of January 1949, and in February 1950 they submitted a Report of 1100 pages.[1] In connection with the Report, the Commission drew up eight bills covering practically every aspect of social life in Greenland. These bills were passed by the Danish Rigsdag (Parliament) in May 1950.

The impact of the recommendations of the Commission and of the new bills, when implemented, will make itself felt in many ways in the Greenland community during the next few years. A brief account of the main changes involved in the new era will be given in this paper.

Population policy

It is planned that the population movement towards larger and more compact settlements, which has existed in recent years, will be encouraged. The extreme difficulty of creating a modern community in Greenland, where the population is distributed in more than 200 small settlements along a coastline of over 1200 miles needs no further comment.

[1] 'Grønlandskommissionens Betænkning', Copenhagen, 1950.

Administration and local government

In the future the administration and local government will be made more effective and more centralized. The sixty-six small local districts will be superseded by sixteen larger districts and the two Provincial Councils, one for North and one for South Greenland, will be replaced by a single Council. The Provincial Council will be presided over by

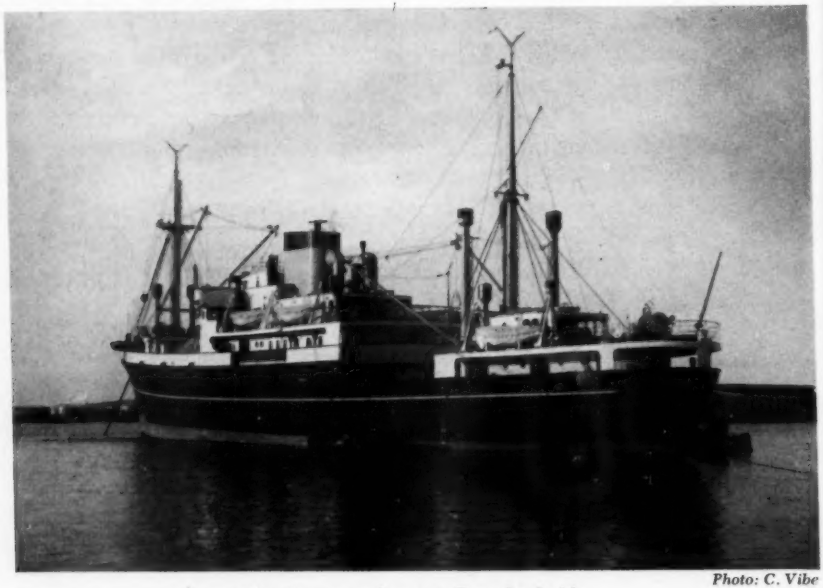


Photo: C. Vibe

The *Umanaq*, the new Greenland ship.

the Governor (Landshøvding) whose powers in many respects correspond to those of the Prefect of a Danish county. The Governor is appointed by the King.

The members of the Local Councils and of the Provincial Council will in future be elected by direct elections, and franchise is extended to all men and women who have completed their 23rd year, and who have been permanently resident in Greenland for a certain time. The Greenland Provincial Council elects two of their members to join the Greenland Committee appointed by the Rigsdag.

Several decisions which were formerly made in Denmark are in future to be made in Greenland, and it is intended gradually to extend the powers of the Provincial Council. First and foremost, the Local Councils in Greenland will be empowered to decide upon matters of social policy, but in return they will have to defray the expense. The revenue which must be made available for administering such social legislation and

other local government affairs, will be found by indirect taxation, in particular from duties on luxury goods.

Trade conditions

It will doubtless be in the field of trade activities that sweeping changes first make themselves felt in the Greenland community. In accordance with the wish of the native population, and in conformity with the recommendations of the Greenland Commission, the ban on the free entry into the country will be repealed on the coming into force of the new Trade Acts. At the same time the Government trading monopoly will practically cease to exist and Danish private enterprise will be admitted, though under some Government control. This development, however, implies the abandonment of the prices policy that has been pursued up to now. So far the price of goods to the Greenland population has often been considerably below cost, while the price paid to the Greenland population for their products has, in times of prosperity, been somewhat below the probable price on the open world market. In future the Greenland population will have to pay the true expenses involved in the purchase and transportation of consumer goods, but in return prices paid for goods produced will be more dependent on the prices ruling on the world market.

In this way production in Greenland will be encouraged, but at the same time the population will lose the benefits derived from the smoothing out of fluctuations in prices. To counteract in some measure the detrimental effects of a fall in the value of goods produced, an organization for the sale of Greenland products will be set up. In times of prosperity this organization will provide for proper appropriations to be made to a fund for less prosperous periods.

The Greenlanders are already able fishermen, and there are hundreds of motor vessels in Greenland. To expand the fishing industry an effort will be made to supply the Greenlanders with larger vessels and better gear on favourable terms, and to give them an adequate training.

To encourage Danish private enterprise to take part in the export of fishery products from Greenland, a special loan fund has been established. Although the Greenland waters abound with fish, the exploitation of these riches is attended with some risk owing to the climatic and geographic conditions, and this special fund will give some financial protection to the exporters.

Health service

Considerable efforts will be made to improve the health service in the next few years. The sickness rate among the Greenland population is very high, and such diseases as tuberculosis and gonorrhoea are prevalent.

Bad housing and defective water supply are largely responsible for this fact, and much energy will be given to solving these problems. New hospitals will be built, the medical staff will be increased, and a Chief Medical Officer (Landslæge) will be appointed for the medical service outside the actual hospital service. The position of this physician will, in many respects, be similar to that of the Chief Medical Officer of a Danish county.

Judicial administration

In the past there have been two different judicial systems in existence in Greenland: some of the people, in particular Danes sent out from the home country, were subject to Danish law, while the Greenland population in general lived under the special Greenland law, which was based on old customs. Particularly the more cultured Greenlanders considered that this dualism discriminated against the Greenland population, and the Greenland Commission has accordingly recommended the introduction of a common judicial system which is to apply to all people living in Greenland.

Bills for a new Criminal Code and a new Administration of Justice Act will be laid before the Rigsdag in the near future. Both bills are based on the principle of equality for all persons living in Greenland, but the bills are adapted to Greenland conditions.

Under the Administration of Justice Act the Prosecution and the Judiciary authority, which in Greenland have hitherto been combined in one person, will, in conformity with the recommendations of the Greenland Commission, be separated in the same manner as in Denmark. Further, the supreme judiciary authority in Greenland will be vested in a Court of Appeal, presided over by a Danish lawyer. The lack of such a superior court in Greenland itself has been seriously felt.

It must not be thought that all Danish Acts will immediately apply to Greenland. The differences in conditions will for a long time to come be too wide. But the endeavour must be to apply fundamental Danish Acts, with such modifications as may be necessary, to Greenland as soon as conditions are suitable.

Education and cultural conditions

One point of importance remains to be mentioned, namely the very considerable effort that must be made to raise the general educational and cultural level. The efforts made in this field will obviously be decisive in obtaining the desired effects of the planned reforms as a whole. At present only a very small proportion of the Greenlanders understand Danish. As there is practically no literature in Greenlandic and no pro-

fessional books, it is obvious that the bulk of the Greenlanders are virtually barred from the world outside Greenland.

The Greenlanders have themselves recognized this fact, and it is in full concord with their wish that the teaching of Danish will now be considerably extended and developed.

A greater number of Danish teachers will be sent to Greenland, and, by way of experiment, a few forms in the primary school will be taught exclusively in Danish. New and larger schools will be erected, and in general an attempt will be made to provide better conditions of training and education.

Education for the adult population will be made available through public lectures, study groups, evening classes, and the radio.

The various measures which are now being implemented in full concord with the Greenland population, will mean a considerable financial burden to the Danish people during the next ten or fifteen years in which the planned reforms will be carried out. Denmark has, however, recognized her responsibility towards Greenland, and it is worth mentioning that the reform program was adopted unanimously by the Commission, and that the bills in connection with the program were passed unanimously by the Danish Rigsdag.

The U.S.S. *Wyandot* in Resolute Bay, August 1948.

JOINT ARCTIC WEATHER PROJECT

By R. W. Rae*

Since Christmas Eve in 1839, when Lieut. C. J. B. Riddell of the Royal Artillery inaugurated a systematic program of meteorological and magnetic observations at old Fort York in Toronto, the Meteorological Division of Canada has grown steadily in importance in providing service to the people of Canada. The science of weather forecasting, although not infallible as yet by any means, has improved considerably since the first storm warning was issued from the Toronto office in 1876. The improvement in the accuracy of daily weather forecasts is due not only to advances in meteorological theory but also to a vast increase in coverage provided by weather observing stations.

The most important periods of growth of the Meteorological Division occurred during the following years: In the 1880's, when telegraphic reporting stations were opened up across the western provinces concurrently with the westward extension of the Canadian Pacific Railway;

*Meteorological Division, Department of Transport.

in the 1920's, when advances in the technique of radio transmission made it possible to install radio reporting stations along the Mackenzie River and in the Hudson Bay and Strait area; and during the years 1947-50, when radio reporting stations were established on some of the remote islands of the Arctic Archipelago.

For many years the region covered by Canada's Arctic Islands appeared on weather maps as a large blank area. The need for weather reports from this blind spot was recognized but the difficulty and expense involved in the establishment and maintenance of communities in these inaccessible regions were prohibitive.

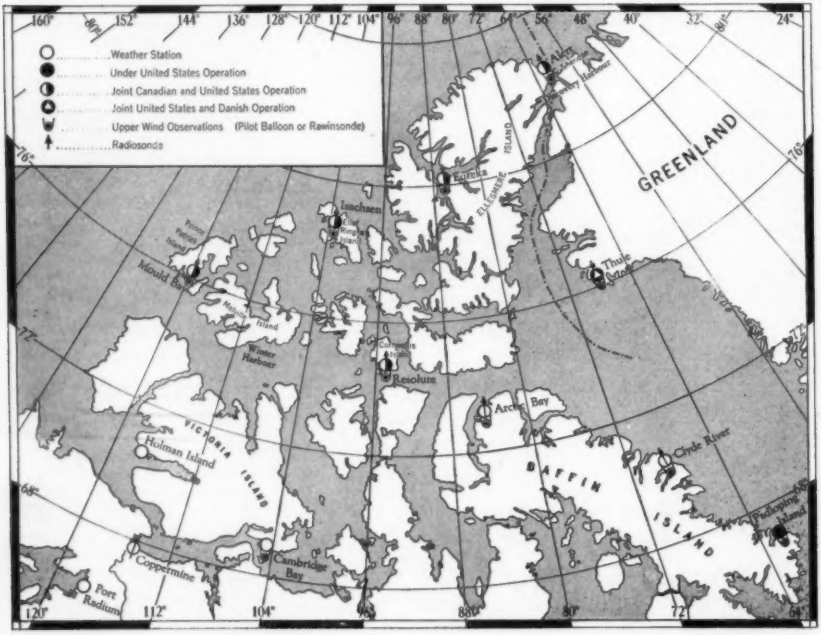
The Second World War aroused renewed interest in the Arctic, and shortly after the termination of hostilities Canada and the United States formulated a plan whereby a number of weather stations at approximately 500-mile intervals across the Arctic Archipelago would be established and operated jointly by the two countries. It is interesting to note that this cooperation between the Canadian Meteorological Service and the United States Weather Bureau for obtaining weather reports from the Canadian North had an early precedent. In 1882, the Chief Signal Officer in Washington wrote to the Director of the Canadian Meteorological Service offering United States assistance in paying the salaries of observers at Fort Chipewyan and Prince Albert. The financial assistance of the United States was not required in this instance for the observer's allowance at Fort Chipewyan was a modest $60 per annum. However, the expense of the present arctic project is so great that it could not be carried out by the Meteorological Division unassisted.

The over-all plan called for the establishment of a central control station with a number of smaller satellite stations which would transmit their reports to the control station for relay to the mainland. It was intended that the main base would be located at Winter Harbour on Melville Island and on 16 July 1947, the U.S.S. *Wyandot*, accompanied by the icebreaker U.S.S. *Edisto*, sailed from Boston for this destination.

Ice conditions in the Western Arctic proved to be much more severe than had been anticipated, and in spite of repeated attempts during August, the icebreaker was unable to force her way through to Winter Harbour. Previous reconnaissance had indicated a suitable alternative site at Resolute Bay on the south shore of Cornwallis Island. This spot is very close to the geographical centre of the Canadian Arctic Islands and was considered to have some advantage over the Winter Harbour location from the standpoint of accessibility by sea and nearness to a suitable airstrip site. Consequently it was agreed that it would be preferable to establish the station at Resolute Bay rather than to postpone the project for a year. This proved to be a wise decision as in 1948 another icebreaker, the

U.S.C.G.C. *Eastwind*, was unable to reach Winter Harbour.

It was especially important that the main station be located near a possible airstrip since it was intended that it serve as an advance base for the establishment and re-supply of the smaller stations by air. The procedure which was adopted for the establishment of these stations requires a considerable amount of skill and courage on the part of the aircrews, since a large proportion of the landings and take-offs must be made on airstrips which have had little or no preparation. The operations are



Weather reporting stations, April 1951.

made possible only by the extensive ice areas in the Arctic, which present a relatively smooth landing surface except for shallow snow drifts.

The region where a new station is to be located is thoroughly surveyed by low-level reconnaissance flights to pick out possible landing areas on the ice. When a likely place has been found an initial landing is made with ski-equipped aircraft and a ground party checks the location to ensure that it meets all requirements such as satisfactory exposure for meteorological instruments and nearness to a supply of fresh water.

If the site is approved, ski-equipped aircraft fly in a small amount of airborne grading equipment to break up and level out the larger snowdrifts in the landing area. As soon as this has been completed, large transport

aircraft on wheels provide a continuous shuttle service to ferry in the men and supplies.

These operations are usually carried out in April since flying conditions in the Arctic are excellent during this month, with winds light and skies mostly clear. Moreover, the thickness of both bay and lake ice in the spring is sufficient to support the weight of the largest aircraft. An additional advantage is that operations can be carried out around the clock since there is continuous daylight or twilight.

The major part of the arctic program has now been completed with the establishment of the following five stations:

Eureka, Ellesmere Island (80°13N., 86°11W.), established in April 1947 by airlift from Thule, Greenland.

Resolute, Cornwallis Island (74°41N., 94°55W.), established in September 1947 by sea transport.

Isachsen, Ellef Ringnes Island (78°47N., 103°32W.), established in April 1948 by airlift from Resolute.

Mould Bay, Prince Patrick Island (76°14N., 119°50W.), established in April 1948 by airlift from Resolute.

Alert, Ellesmere Island (82°29N., 62°15W.), established in April 1950 by airlift from Thule, Greenland.

Establishment of Alert

Alert, the newest of the joint arctic weather stations is situated on northern Ellesmere Island, near the most northerly point of land in North America. The choice of the name "Alert" for the weather station was a fitting one for it serves as a reminder of the expedition which made the greatest contribution towards an accurate survey of this coast.

In 1875, a British expedition consisting of two ships, the *Alert* and the *Discovery*, under the command of Captain (later Admiral Sir) George Nares, wintered on the north coast of Ellesmere Island. The *Discovery* made her winter quarters at Discovery Harbour (81°44N., 65°03W.) where Greely later established Fort Conger. The *Alert* forced her way farther northward until difficult ice conditions brought her to a halt in latitude 82°24N., near Cape Sheridan. Numerous sledge trips were made from the ship during the winter to survey and map the north coast of Ellesmere Island and the northeast coast of Greenland. Several years later, Her Majesty's Government re-fitted the *Alert* to provide assistance in the rescue of the ill-fated Greely expedition. When she was no longer required for this purpose, she was handed over to the Dominion Government and was used in the years 1885 and 1886 on the Canadian Government expeditions to Hudson Bay and Strait.

The preliminary reconnaissance for a weather station site on the north coast of Ellesmere Island was carried out by icebreaker in the summer of 1948, and some supplies were left cached there such as fuel, emergency rations, temporary shelters, and a small tractor. However, the final phase of the establishment of the station was not undertaken until the spring of 1950. The initial landing was made on Easter Sunday and construction work was begun immediately. As soon as the tractor could be started, it was used to improve the landing area on the ice and the remainder of the supplies were ferried from Thule in a round-the-clock airlift.

It may be mentioned that Alert is now the most northerly post office in the world, a distinction that was previously held by Eureka. Mail delivery to the joint arctic stations is accomplished by air about every month or so on the average. Consequently, they are isolated only to the extent that they are far removed from settlements of any kind. Each station has an island to itself with the exception of Alert and Eureka which are both on Ellesmere Island. Today there are no Eskimo on the far northern islands though there is ample evidence of sizable Eskimo settlements in the past, especially along the shores of Barrow Strait and Lancaster Sound.

Special Arctic Problems

Many special problems are encountered in the operation of an isolated arctic station. The following three problems are among the most important:

Fire protection
Winter water supply
Morale.

Fire is a very real and serious hazard at an arctic station. This is especially true during the winter months when the low temperatures require heating units to be operated at, or near, their maximum output. Moreover, the cold winter air dries out the wood to such an extent that if a fire starts it is almost immediately out of control. For this reason the buildings should be spaced some distance apart so that if a fire occurs in one building it will not spread to the others.

In the Arctic the usual procedure for obtaining fresh water in winter is to melt snow or ice. However, it was found at Resolute that this method required so much time and heat that it was necessary to ration water during the first winter for such uses as washing clothes and bathing. An improved system was devised the second year which permitted fresh water to be hauled from a nearby lake all winter, even when the thickness of the lake ice had increased to eight feet. The main problem was to keep a water hole open and so avoid the necessity of chopping through several

feet of ice every few days. This was accomplished by a method which is not used anywhere else as far as we know.

In the fall when the ice was between one and two feet thick, a 9-foot length of 3-inch pipe was frozen into the ice with its top end just above the surface. Then a 3-foot extension was screwed to the top. This 3-foot length provided sufficient pressure head that when aviation gasoline was poured in, the gasoline forced the water completely out of the pipe. Instead of a pipe full of water, there was now a pipe full of gasoline

Ice in Resolute Bay, off Martyr Point, March 1949.

embedded in the ice. When it was necessary to haul water, the extension was unscrewed and the water pressure from below forced the gasoline out of the pipe, which was then linked to the intake hose and pump. In below-zero weather the intake hose and pump were kept from freezing by means of a Herman-Nelson aircraft heater.

Maintenance of morale depends largely on the type of personnel at the station. Great care must be exercised in screening applicants for these posts since one unsuitable individual can disrupt the harmony of the entire station. In addition to having a thorough technical knowledge of the work, personnel for isolated arctic duty should be cheerful and considerate, willing to cooperate with others, and prepared to keep living and working quarters clean and tidy.

Scientific Program

The scientific work at the joint arctic weather stations includes a very full program of meteorological observations, both surface and upper air. These observations are collected by radio at Resolute and transmitted to Edmonton where they are immediately put on the teletype circuits which feed meteorological information to the forecast offices in Canada and the United States. The arctic observations are also made available to European centres by means of radio-teletype from New York to Paris.

Many special scientific investigations are being carried out in addition to the regular observing program, not only by the station staff but by visiting scientists as well. For example, the following investigations were carried out by the staff at Resolute during the first two years of operation:

Measurements of the rate of accretion of sea ice.

Determination of temperature gradients in sea ice.

Observations of the temperature gradient in the lower layers of the atmosphere from ground level to a height of 75 feet.

Measurements of temperature gradients in soil and permafrost, and the depth of the active layer.

Determination of the tidal range.

Investigation of the relative merits of two types of prefabricated arctic buildings.

Winter test of special arctic clothing.

Observations of snow characteristics.

Climatic Notes

Average winter temperatures throughout the Arctic Islands are consistently low. For seven months of the year, from October to April, mean monthly temperatures are well below zero. From 11 November 1948 to 17 April 1949 the temperature at Eureka rose above zero on only three occasions. Some idea of the temperature difference between this region and the southern parts of Canadá may be obtained from the fact that the mean annual temperature at Toronto, for example is 45°F, whereas the corresponding average temperature at Eureka is -3°F.

If we define winter as the period from the time that the snow first stays on the ground until the time that the ground is again snow-free, winter lasts from the beginning of September to the end of June in the Arctic Archipelago. This leaves only the months of July and August for spring, summer, and fall. During the brief summer period, the ice-filled polar waters, with a surface temperature near 30°F, prevent the air in contact with them from warming up to any great extent. Moreover, any incursion of warm air from the south is cooled rapidly in its lower layers by contact with the cold water. As a result, summer temperatures

are low and the extreme high may not reach 60°F in some years. Mean summer temperatures show little variation from year to year and the average temperature of the warmest month, July, is usually near 40°F.

Annual precipitation is generally under five inches which is less than that of the driest parts of the Prairie Provinces. Snowfall is relatively light in the winter since air temperatures are so low that the amount of precipitable water vapour is extremely small. In open country the snow on the ground is rarely over 12 inches deep and the ground is bare in

Near Resolute weather station, July 1949.

many spots. However, deep compact drifts are deposited around obstacles and in hollows. These drifts form rapidly during the storms of blowing snow which occur about every two or three weeks throughout the winter. The precipitation during July and August is chiefly in the form of light rain or drizzle, although snow may fall in any month.

The station which reports the lowest annual precipitation is Eureka with a mean total of 1.62 inches over a two-year period. In temperate zones an annual figure of this magnitude is found only in desert regions.

An indication of the temperature and precipitation regime over the northern Arctic Islands may be obtained from the following records taken at the joint arctic weather stations:

Monthly and annual mean temperatures and extreme temperatures (°F)

	Eureka	Isachsen	Mould Bay	Resolute
January	-37	-37	-32	-28
February	-41	-29	-31	-35
March	-31	-27	-20	-26
April	-20	-20	-11	-11
May	13	12	11	12
June	38	31	29	33
July	43	38	38	41
August	38	34	34	38
September	21	16	18	23
October	-3	-3	0	7
November	-20	-16	-17	-6
December	-41	-37	-28	-21
Year	-3	-3	-1	2
Highest	66	64	57	59
Lowest	-63	-55	-63	-55

Mean monthly rainfall and snowfall in inches and mean annual precipitation converted to inches of water

	Eureka		Isachsen		Mould Bay		Resolute	
	Rain	Snow	Rain	Snow	Rain	Snow	Rain	Snow
January	0	1.1	0	1.4	0	0.4	0	0.4
February	0	0.6	0	0.2	0	0.5	0	1.2
March	0	1.4	0	0.7	0	1.2	0	1.6
April	0	0.1	0	0.5	0	0.4	0	1.0
May	0	2.0	0	4.6	0	1.0	0	8.0
June	0.01	0.1	trace	2.0	0.06	2.5	0.56	2.0
July	0.27	0	0.49	0.7	1.04	0.2	1.10	0.7
August	0.23	0.6	0.47	0.3	0.25	1.6	0.62	1.7
September	0	2.8	0	7.7	trace	4.7	0.32	7.4
October	0	1.0	0	2.7	0	1.2	0.01	5.2
November	0	1.0	0	4.1	0	0.6	0	2.4
December	0	0.4	0	0.1	0	0.1	0	0.5
Year	1.62		3.46		2.79		5.82	

These far northern weather stations are undoubtedly expensive and difficult to maintain. However, they provide basic meteorological data from a hitherto unknown region which will permit research to be carried out on the large scale movements of the earth's atmosphere. An improved understanding of atmospheric processes will pave the way for improved forecasting techniques. The research cannot be done without the observational data and the data cannot be obtained without the stations.

THE GROWTH OF THE SOVIET ARCTIC AND SUBARCTIC

By C. J. Webster

I

THE physical indices essential to the study of the economic growth of the Soviet Arctic and Subarctic have long been rare, and have virtually ceased to appear. Those available are discontinuous, imprecise, and frequently conflicting. Yet, if these are collated from a wide range of periodicals and monographs, a crude pattern does emerge. From a study of this literature, recording years of research and experiment, it is also possible to gain some conception of the difficulties which have been encountered, and of the extent to which these have been overcome. To divorce the statistics from their context is to rob them of their full significance. Perhaps more important, to omit this context is to ignore the perspectives for the most probable current and future development of the Soviet North. Bearing this in mind, this paper will attempt to assemble only those data concerning claimed developments which appear to be consistent, and, finally, in the light of these, to examine the apparent growth of population.

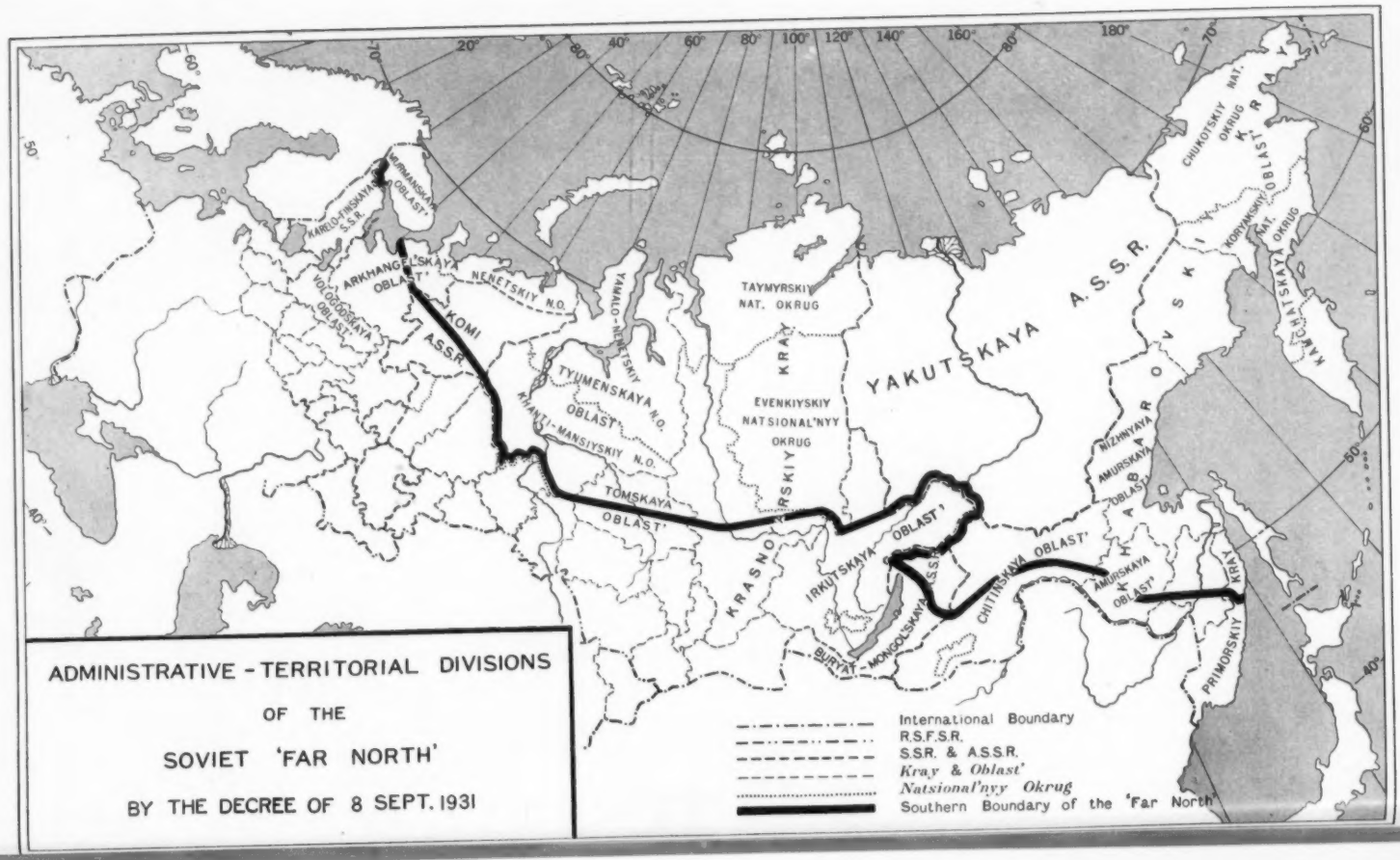
Under the term "Soviet Arctic", the government of the U.S.S.R. connotes all the lands and waters which lie north of the Soviet Union and between the meridians of 32° 04′ 35E. and 168° 49′ 36W.[1] Most Soviet writers accept the Arctic as extending south to the wooded tundra. For the purposes of this paper, a southern boundary for the Soviet Subarctic is less easily established. Soviet attempts at a definition of this line are of little help.[2] But assistance may legitimately be sought in that which has emerged in Soviet practice.

West of the Urals, conditions which may be termed "subarctic" prevail everywhere at least north of 60°N.; east of the Urals, the same conditions obtain everywhere throughout the R.S.F.S.R.[3] Within this subarctic zone lies the great boreal forest of Eurasia. During one thousand years of expansion north and east into this forest, the Russian population has met increasing resistance to its advance. In the European North, a region traversed from the ninth century by freight routes to the Arctic, some settlement probed on as far as the Arctic Circle; but widespread agricultural settlement ceased in the vicinity of 60°N. In Siberia, continuous settlement has been restricted to a narrow band along

[1] *Sobraniye Zakonov i Rasporyazheniy S.S.S.R.*, Vol. 1, No. 32 (1926).

[2] On the basis of radiation and atmospheric circulation, A. A. Grigor'yev has defined "physico-geographical" zones of equatorial, subtropical, subarctic, and arctic environment. By this method, he places the southern boundary of the Subarctic between 67° and 73°N., *Subarktika*, (1946) p. 6.

[3] Roberts, B., "Administrative divisions of the Soviet Arctic and Sub-arctic", *Polar Record*, No. 31 (1946) pp. 320-3.


ADMINISTRATIVE - TERRITORIAL DIVISIONS
OF THE
SOVIET 'FAR NORTH'
BY THE DECREE OF 8 SEPT. 1931
MURMANSKAYA OBLAST'
KARELO-FINSKAYA S.S.R.
ARKHANGEL'SKAYA OBLAST'
VOLOGODSKAYA OBLAST'
NENETSKIY N.O.
KOMI A.S.S.R.
YAMALO-NENETSKIY N.O.
TYUMENSKAYA OBLAST'
KHANTY-MANSIYSKIY N.O.
TOMSKAYA OBLAST'
TAYMYRSKIY NAT. OKRUG
KRAY
EVENKIYSKIY NATSIONAL'NYY OKRUG
YAKUTSKAYA A.S.S.R.
KRASNOYARSKIY KRAY
IRKUTSKAYA OBLAST'
BURYAT-MONGOLSKAYA A.S.S.R.
CHITINSKAYA OBLAST'
KHABAROVSKIY KRAY
AMURSKAYA OBLAST'
NIZHNYAYA AMURSKAYA OBLAST'
CHUKOTSKIY NAT. OKRUG
KORYAKSKIY NAT. OKRUG
KAMCHATSKAYA OBLAST'
PRIMORSKIY KRAY
International Boundary
R.S.F.S.R.
S.S.R. & A.S.S.R.
Kray & Oblast'
Natsional'nyy Okrug
Southern Boundary of the 'Far North'

the southern edge of the forest, through which the Trans-Siberian Railway has been built. North of these limits, Russia in 1917 remained a cold and virtually undeveloped wilderness, difficult of access, and inhabited mainly by non-Slav natives pursuing a primitive, nomadic subsistence economy. But this was territory which generations of warriors, traders, travellers, and explorers had revealed to contain immense wealth, only a little of which had begun to be exploited. In the conditions of international isolation and domestic reconstruction which followed on war, revolution, and intervention, the new government decided that it had urgent need of this wealth, and of the sea route through the Barents and Kara seas.[4] But to find and exploit this wealth it was necessary to develop transport and communications; to import Russian labour, food, and machinery; to found settlements; and to analyse the intricately balanced forest economy of the natives, if this was not to be disrupted by the imposition of a Russian pattern. Thus, in the years immediately following 1917, historical, demographic, and economic factors combined to define an immense region in the north of Russia, throughout which subarctic conditions prevailed, and in which the young Soviet government saw a special economic problem.

Towards the end of the First Five-Year Plan (1928-1932), when the planned development of the Russian North as a whole properly began, the government undertook the precise definition of this region. The "Far North" (*Kraynyy Sever*), henceforth a specific concept, was described by a decree of 8 September 1931 as consisting of the following units:[5]

Murmanskaya Oblast'
Northern portions of the Arkhangel'skaya Oblast', including the Nenetskiy Natsional'nyy Okrug
Northern portions of the Komi A.S.S.R.
Tyumenskaya Oblast', including the Yamalo-Nenetskiy and Khanti-Mansiyskiy *natsional'nyye okrugi*
Northern portions of the Tomskaya Oblast'
All of the Krasnoyarskiy Kray north of approximately 57°N., including the Taymyrskiy (Dolgano-Nenetskiy) and Evenkiyskiy *natsional'nyye okrugi*
Yakutskaya A.S.S.R.
Northern portions of the Irkutskaya and Chitinskaya *oblasti*, and of the Buryat-Mongol'skaya A.S.S.R.
Virtually all of the Khabarovskiy Kray, south to (and including northern portions of) the Amurskaya Oblast'
Primorskiy Kray, north of the Khor and Samarga rivers
All islands of the Arctic Ocean, and of the Okhotsk, Bering, and Kamchatka seas.

[4]Yegorov, K., and S. Slavin, "V. I. Lenin i Razvitiye Sovetskoy Arktiki", *Sovetskaya Arktika*, No. 1 (1941) pp. 10-20.

[5]Soviet political geography in this region has been perhaps even more dynamic than normally. The text of the decree, giving the above units by the names by which these were known in 1931, is quoted in Taracouzio, T. A., 'Soviets in the Arctic', 1938, App. XX, p. 455. A map showing the southern boundary of the "Far North" occurs in Khrapal', K., 'Sel'skoye Khozyaystvo Aziatskogo Severa', 1940, p. 1.

It would appear that the northern limit of relatively continuous Russian settlement has been used to define the southern boundary of the "Far North".[6] It will be noted that the larger portion of the European North is excluded. Yet the nature of this region, the bulk of which is accepted by the Academy of Sciences as a geographical unit,[7] is such that it demands inclusion in a study of the Subarctic. In Siberia, most of the "Far North" lies north of 60°N. On the other hand, to the east of Ozero Baykal, it extends south to beyond 55°N. and even 50°N. In this district, it may be argued that subarctic conditions are the result of continental rather than arctic influences. The "Far North", then, is not a completely satisfactory "Subarctic".

In order to expedite the development of the Siberian "Far North", the government has organized penetration from two directions: from the Arctic Ocean in the north, and from the railway in the south. The boundary between the two parts into which Siberia was thus divided was settled as roughly the latitude of the city of Yakutsk (approximately 62°N). After 1932, the development of all Siberian territory north of this latitude, which came to be oriented principally toward the Arctic basin, was made the responsibility of the Main Administration of the Northern Sea Route (G.U.S.M.P.).[8] South of this line, the development of the "Far North" was left to the normal organs of federal, republican, and local government. Since that date, most Soviet writers on the Siberian Subarctic have tended to concern themselves with the region north of 60°N.

For these reasons, that part of the U.S.S.R., both European and Asiatic, which lies north of 60°N., will be considered the "Subarctic" of this study.

II

Transport

The key to the economic development of the Soviet Arctic and Subarctic has been transport. Of the Northern Sea Route, it is sufficient to note that the government has built a chain of ports, meteorological stations, and coastal installations extending from the Kol'skiy Poluostrov eastwards to the Chukotskiy Poluostrov. By 1940 about one hundred navigational aids had been set up in the Kara Sea alone. The main ports appear to be Murmansk, Arkhangel'sk, Novyy Port, Ostrov Diksona, Igarka, Bukhta Tiksi, Ambarchik, and Bukhta Provideniya. Along this

[6]Pavlov, M., and V. Goroshchenko, 'Geografiya S.S.S.R.', 1946. The ethnographic map on p. 42, which shows the northern limit of relatively continuous Russian settlement, has been taken from a map at the end of this volume.

[7]Rikhter, G., 'Sever Yevropeyskoy Chasti S.S.S.R.', 1946, p. 7.

[8]Since 1939, the G.U.S.M.P. appears to have been relieved of much of its continental responsibilities.

route, over one hundred polar stations of various types have been established; of these, it is claimed that seventy operated throughout the Second World War. In 1938 a total of 104 vessels were active in these waters, exclusive of icebreakers. It is reported that, during the Second Five-Year Plan, a total of 1,188,000 tons of freight were shipped along this route. The target for the Third Five-Year Plan (1932-7) was 2,631,000 tons. Figures for the present Plan are not available; but it is claimed that the volume of freight increased by 80 per cent between 1940 and 1945. These figures represent a very small fraction of the freight traffic on the Trans-Siberian Railway; but they acquire interest when it is remembered that the bulk of this tonnage consists of shipments to and from the arctic ports, where supplies for, and some of the output of, the Subarctic is transshipped from the river fleets. As long ago as 1936, these fleets amounted to 60 vessels and 146 barges, which carried over 200,000 tons in the following year. Mention must also be made of the Stalin Canal[9] (Belomorsko-Baltiyskiy Kanal Imeni Stalina), which was opened in 1933, and which permits the passage of light naval units from the Baltic to the White Sea. Finally, although the ambitious plan for the "Southern Taymyr Water Route" to link the mouths of the Yenisey and Lena rivers has not been realized, the Pyasina waterway has been considerably improved.[10]

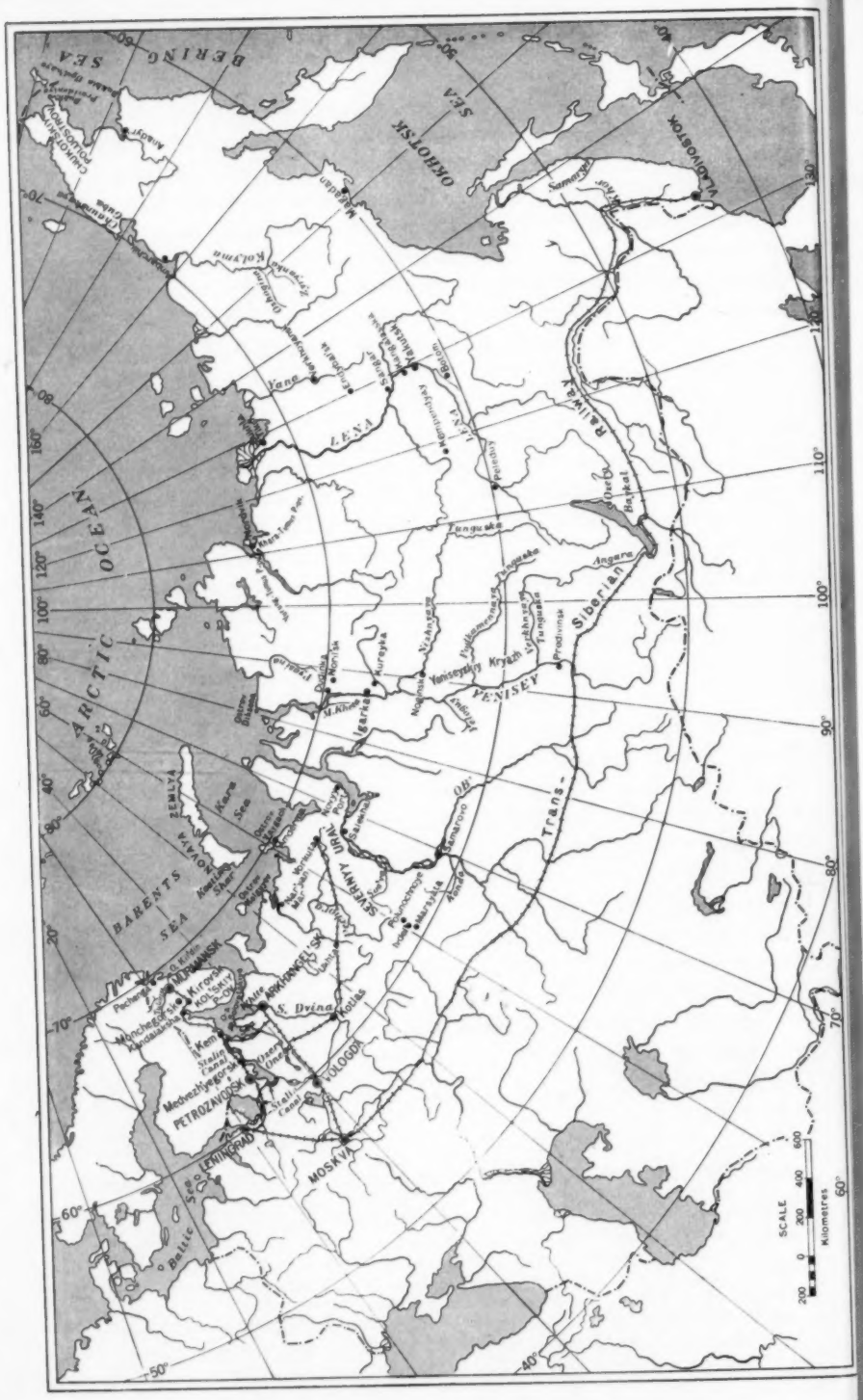
The European North is the only area of the Soviet North which is relatively well served by railways. That part of the "Kirov" line (the Leningrad-Murmansk Railway) which crosses the Kol'skiy Poluostrov has long been electrified, and the Arkhangel'sk-Vologda route has been double-tracked for many years. Early in the Second World War, the crucially important line to Vorkuta was rushed through from the vicinity of Kotlas.[11] A dirt road now exists along the Yenisey from the Trans-Siberian Railway to Igarka, and Dudinka is linked with Noril'sk by a narrow-gauge railway.[12] In the Soviet Far East, an unmetalled road joins Magadan with the headwaters of the Kolyma; around its northern terminus a complex net of communications has been developed throughout the gold-fields. In addition, a large number of deer-tracks have long been

[9] Owing to the length of the Russian name the English name has been given on the map on p. 32.

[10] Yanson, N., "Plan Raboty Sevmorputi v 1937 Godu", *Sovetskaya Arktika*, No. 2 (1937) pp. 14-23.
Mandel, W., "Some notes on the Soviet Arctic during the past decade", *Arctic*, Vol. 3 (1950) pp. 55-62.
Levichev, T., "Reki Kraynego Severa v Sluzhbe Sotsial'nogo Stroytel'stva", *Sovetskaya Arktika*, No. 9 (1937) pp. 19-22.
Problemy Arktiki, No. 1 (1938) pp. 99-102.

[11] Vol'fson, L., et al., 'Razvitiye Zheleznikh Dorog S.S.S.R.', 1939.
Polar Record, Vol. 4, No. 29 (1945) pp. 236, ff.
Trudy Instituta Merzlotovedeniya, Vol. 2 (1945) pp. 121-213.

[12] Suslov, S. P., 'Fizicheskaya Geografiya S.S.S.R.', 1947, map "Zapadnaya Sibir'."


BERING SEA
OKHOTSK SEA
VLADIVOSTOK
ARCTIC OCEAN
LENA
Lena
Yana
Kolyma
Anadyr
Yakutsk
Aldan
Olekminsk
Vitim
Tunguska
Angara
Baikal
Trans-Siberian Railway
Irkutsk
Krasnoyarsk
Yeniseysk
Kureyka
Igarka
Dudinka
Turukhansk
YENISEY
Ob
Obdorsk
Salekhard
Berezovo
Beloyarsk
Sverdlovsk
URAL
Nizhni Tagil
Chelyabinsk
Kustanay
Petropavlovsk
Omsk
Tyumen
Tobolsk
Kotlas
Kirov
Gorki
MOSKVA
Moscow
LENINGRAD
Leningrad
Baltic Sea
Kara Sea
NOVAYA ZEMLYA
BARENTS SEA
MURMANSK
Murmansk
ARKHANGELSK
Archangel
S. Dvina
VOLOGDA
Vologda
PETROZAVODSK
Petrozavodsk
Kem
White Sea
Stalin Canal
Volga-Don Canal
Volga
SCALE
Kilometres
0
200
400
600

used for overland travel, at least once by motor transport.[13]

Prior to the outbreak of the Second World War, air transport in the Soviet North does not appear to have been as developed as the spectacular transpolar flights of 1937, the landing of the Papanin North Polar Drift Expedition at the Pole, and the transarctic flights of Molokov in 1938 might seem to have implied. Regular lines do operate northward along the great rivers to the Arctic, and personnel and freight are delivered to many points in the interior. In the past fifteen years, aircraft have been increasingly used for various types of aerial surveys, to serve the sealing and fishing fleets, and, particularly, in the ice-forecasting service of the G.U.S.M.P.[14]

Mining

In the Kol'skiy Poluostrov, a mining centre of national importance has been developed around Kirovsk, where the world's largest apatite deposit yielded 2,000,000 tons in 1938.[15] From Monchegorsk and Pechenga (Petsamo) much of the total Soviet output of nickel, as well as some platinum and cobalt, are obtained. It has been the intention that the Kandalaksha aluminium plant should use cyanite from Keiv (some fifty miles to the northeast) and nephelite from Kirovsk, which produced 500,000 tons of nephelite in 1942.[16] Quartzites, graphite, and mica are mined, and gypsum, cement, and bricks are manufactured locally. Reserves of monazite, niobium, and beryllium have been found in nationally important quantities; and it has been planned that the sulphuric acid industry would be established in this peninsula during the Fourth Five-Year Plan (1945-50). It is not clear that any progress has been made in the development near Leningrad of the "Northwest Metallurgical Combine", which was intended before the outbreak of the Second World War to use low-grade iron from the Kol'skiy Poluostrov and coal from the Pechora valley.

In the Karelo-Finskaya S.S.R., from the region between Kem' and Kandalaksha, the Soviet ceramics industry drew 80 per cent of its raw materials in 1940.[17] Copper is mined at Medvezh'yegorsk and some fifty miles to the north. Elsewhere, titanium, molybdenum, and zirconium are recovered.

[13] *Sovetskaya Arktika*, No. 9 (1939) p. 114.

[14] *Sovetskaya Arktika, Byulletin' Arkticheskogo Instituta, Lesnaya Promyshlennost', Gornyy Zhurnal', Problemy Arktiki*, etc., 1930-41.
Akkuratov, V., 'V Vysokikh Shirotakh', 1947.
Pavlov, M., and V. Goroshchenko, 'Geografiya S.S.S.R.', 1946.

[15] Tyrell, G. W., "Apatite, nepheline, and rare-earth mining in the Kola Peninsula", *Nature*, Vol. 141 (1938) p. 355.

[16] *Anglo-Soviet Journal*, Vol. 3, No. 4 (1942) pp. 214, ff.
Höffding, O., 'Die Nicht-Eisen-Metallwirtschaft der Sowjetunion', 1939, p. 62.

[17] *Anglo-Soviet Journal*, Vol. 1, No. 3 (1940) pp. 255, f.

Farther east, near Ukhta (formerly Chibyu), the output of oil reached 50,000 tons in 1937, and a cracking-plant of the same capacity was built.[18] It appears that the output will have increased to about 325,000 tons in 1950.[19] Radium has been recovered in this district since 1940.[20] About 7,000,000 tons of coal were produced by the Pechora valley in 1947;[21] in this field the effort put into exploitation has resulted in a rise in annual output of over 6.6 million tons in fifteen years, partly as a result of increased demand, partly because of the destruction of the mines on Svalbard, which the U.S.S.R. had been operating since the early 'thirties, and which had sent most of their output (500,000 tons in 1936) to the European North.

During the Second World War, the Urals mining industries expanded considerably, but pushed north only to the vicinity of Ivdel', barely across the 60°N. parallel. Twenty-five miles to the south, at Krasnaya Shapochka, the Northern Urals Bauxite Mine began operations, and three of the four adjacent iron-workings were founded in 1943. Manganese is obtained at Marsyata and Polunochnoye. The region also yields limestones, fireclays, and quartzites. On the Arctic coast to the north, the Amderma spar mine was already producing 8,890 tons of fluorspar by 1935, and Ostrov Vaygach by the same date had yielded 11,000 tons of lead and zinc.[22] The copper of Kostin Shar on Novaya Zemlya now appears in Soviet text-books as an important deposit.[23]

Except for small quantities of oil on the Malaya Kheta, the mineral wealth below the thick Quaternary sediments of Western Siberia has not yet been uncovered. In Central Siberia gold is mined in the Yeniseyskiy Kryazh (Yenisey Range), graphite at Kureyka and Noginsk, and the working of the Nizhnyaya Tunguska spar deposits began in 1942. The celebrated Noril'sk Combine (mine, refinery, and smelter) produces copper, nickel, platinum, gold, and coal. At Nordvik, the war forced up the production of salt from 2,400 tons in 1942 to 34,000 tons in 1944,[24] and by 1940 *Glavsol'*, the Main Administration of the Salt Industry, was extracting 3,000 tons a year at Kempendyay.[25] A small flow of oil has

[18] *Moscow News*, 24 March 1945.

[19] Estimate based on data published in *Planovoye Khozyaystvo* (February 1945); *Neftyanaya Promyshlennost'* (August 1946 and January 1947); *Pravda* (1 January 1947 and 1 March 1947).

[20] *Soviet War News*, 16 December 1943.

[21] Estimate based on data published in *Za Ekonomiyu Topliva*, *Pravda*, and *Izvestiya*, 1946-48.

[22] Kiselgof, Ye., "Amderma", *Sovetskaya Arktika*, No. 9 (1937) p. 97.
Trudy Arkticheskogo Instituta, Vol. 134 (1939) p. 10.
Sovetskaya Arktika, No. 2 (1935) p. 88; and No. 10 (1936) p. 26.

[23] Pavlov, M., and V. Goroshchenko, 'Geografiya S.S.S.R.', 1946, *see* map at end of volume.

[24] *Nedra Arktiki*, No. 2 (1947) pp. 147-74.

[25] *Sovetskaya Arktika*, No. 7 (1940) pp. 22-7.

been obtained on the Khara-Tumus and Yurung-Tumus peninsulas. Kangalasska yielded 14,000 tons of coal in 1936, and Sangar about 23,000 tons in the same year.[26] Near Bukhta Tiksi, along the Sogo River, ten shafts were sunk into brown coal in 1943.[27] A year later, the Botom iron works were reported to have an annual capacity of 250,000 tons of pig iron.[28]

There has been considerable mining activity for a number of years in the Far Northeast. Lead and silver have been mined at Endybal'sk since 1936. Tin has been obtained at Adzhakinsk in the upper Yana basin since 1939. In 1946, reference was made to a "polymetals combine" on the Yana, probably at Verkhoyansk.[29] The development of the Kolyma valley remains shrouded in secrecy. Former Polish prisoners have reported that some 66 gold-fields have been opened up.[30] That an enterprise of very considerable stature is located here is suggested by the advertisements for free labour run in the Soviet press in 1947 by *Dal'stroy*, the organization responsible for the development of the Kolyma valley.[31] This enterprise draws at least some of its coal from local deposits on the Ozhogina and Zyryanka rivers. There is little doubt that the enormous cassiterite deposits of the Chaunskaya Guba region, which were the object of increasing investment prior to 1941, are now exploited.[32] By 1940, Bukhta Ugol'naya was producing coal.

Fisheries

The "Northern Basin" of the Soviet fisheries industry, comprising the waters of the Barents and White seas, are exploited by a state trust based on Murmansk, which probably possessed 50 to 80 trawlers in 1942. The coastal cooperatives responsible for the northern fishing were equipped in 1939 with some 300 powered craft.[33] In 1947, it is claimed that the trawlers took 135,000 tons; the 10,255 tons taken by the vessels of the cooperatives, which had been badly depleted by the war, had not regained the pre-war (1937) level of 14,306 tons.[34] Since the end of hostilities, the trawlers have endeavoured to extend the area of herring operations to the waters off Greenland and Iceland. East of the Urals, the picture has remained obscure. By the middle of the Second Five-Year Plan, 66

[26] *Sovetskaya Arktika*, No. 7 (1937) pp. 67, f.; and No. 6 (1940) pp. 70-3.
[27] *Nedra Arktiki*, No. 2 (1947) pp. 113-7.
[28] Gregory, J. S., and D. W. Shave, 'The U.S.S.R., a geographical survey', 1944, p. 320.
[29] *Nedra Arktiki*, No. 2 (1947) p. 117.
[30] Dallin, D. J., and B. Nicolaevsky, 'Forced labour in Soviet Russia', 1947, pp. 108-46.
[31] *Trud*, 6 February 1947, 23 April 1947; *Vechernyaya Moskva*, 20 February 1947; *Pravda Ukrainu*, 12 March 1947.
[32] *Sovetskaya Arktika*, No. 3 (1938) pp. 111-7.
[33] *Rybnoye Khozyaystvo*, No. 8 (1947) p. 21.
[34] *Rybnoye Khozyaystvo*, No. 2 (1945) p. 4; No. 11 (1947) pp. 13-6.
Izvestiya, 28 April 1948.

powered vessels and 221 barges were employed in the fisheries of the lower Ob'; thirteen years later, there appear to have been eighteen canneries in the region. Less progress has been made on the Yenisey and the Lena. During the war, the Union government assumed control of the industry on all the Siberian rivers, and the total catch is said to have risen from 54,000 tons in 1941 to 135,000 tons in 1943.[35] By the outbreak of war, the "Far North" supplied all its own canned fish, and about 20 per cent of the total Union catch. In 1950, it was planned that 220,000 tons would be taken, of which the bulk (100,000 tons) was to come from the Barents Sea, 80,000 tons from the Ob', and about 20,000 tons from other northern rivers.[36] The value of this output to a country, for which fish constitutes the principal protein element in a dominantly farinaceous diet, is obvious. Little is known of the present seal catch; 197,000 animals were taken in the Barents, White, and Kara seas in 1945.[37]

Timber

In the 'thirties, the subarctic timber industry reached its maximum development in the European North. By the end of the decade about thirty mills lined the waterways between Leningrad and the Kol'skiy Poluostrov; a further twenty-six clustered around the estuary of the Severnaya Dvina.[38] From the European North came about one-third of the lumber destined for domestic use and export. The "Far North" exported most of its timber output, two-thirds of it through Igarka, where three mills had been built by the end of the Second Plan.[39] The post-war tendency is to use the timber from the European North for domestic purposes only and to switch production for export to Western and Central Siberia. To date, some increase in production in the Yenisey valley seems probable. At the same time production has shifted farther south, and the Angara forests, which in 1945 produced some 345,000 cubic metres out of the 510,000 cubic metres for the whole Yenisey basin, are being increasingly utilized to feed the Igarka mills.[40] Small mills are probably in operation at Salekhard, Samarovo, Predivinsk, and Peleduy, as well as in the central parts of the Khabarovskiy Kray.

Furs and Game

The available statistics throw no light on the exploitation of furs and game. That the G.U.S.M.P. in 1937 was responsible for 391 fur factories,

[35] *Rybnoye Khozyaystvo*, No. 2 (1947) pp. 1-7.
[36] *Rybnoye Khozyaystvo*, Nos. 4-5 (1946) pp. 3, f.; No. 2 (1947) pp. 13-6; No. 11 (1947) pp. 13, ff. (80,000 tons from the Pacific and the Black and Caspian basins).
[37] *Rybnoye Khozyaystvo*, No. 8 (1946) pp. 25, ff.
[38] *Sovetskaya Arktika*, No. 7 (1940) pp. 91-3.
[39] *Sovetskaya Arktika*, No. 10 (1936) p. 41.
[40] *Les*, No. 2 (1947) pp. 23-9.

113 of which were mobile, 20 P.O.S. and P.P.S.,[41] and 6 breeding farms, shows that the industry was not entirely neglected. The larger type of breeding farm has been reported from the islands of Kolguyev, Kil'din, and the Solovetskiye group only. Beaver have been established in the Chuna Tundra reserve on the Kol'skiy Poluostrov, in the Konda and Sos'va valleys of the Severnyy Ural', and near Ozero Onega. A reserve did exist on the Pechora. Muskrat have been set out on the Yeloguy, Podkamennaya Tunguska, and the Kolyma rivers. Thousands of geese and ptarmigan are taken every year by the natives on the tundra; however, there is no evidence as to the scale and nature of modern exploitation of the several million wildfowl of Novaya Zemlya, historically an important source of food and down.

Agriculture

Ever since the adoption of a planned economy, the Soviet government has tried hard to reduce the large quantities of food which must annually be imported into the "Far North". The effort to develop local agriculture has called for protracted study, much experimentation, the collectivization of the natives, the supply of implements through the establishment of Machine-Tractor Stations (M.T.S.), and the organization of research stations and state farms. The disastrous effect of the early attempts to collectivize the natives is seen in the drop in the number of reindeer in the Siberian portion of the "Far North" from 1.6 million in 1926 to 1.1 million in 1933; by 1937 the figure was still only 1.3 million.[42] However, by the end of the Second Plan, it was claimed that two-thirds of the natives had been collectivized, and that 704 tractors were in use north of 60°N.; but the process was still under way on the tundra in 1947.[43]

By 1939, it was claimed that the All-Union Institute of Polar Agriculture, Animal Husbandry, and Industrial Economy, with its headquarters at Igarka, controlled twenty-five research stations, of which six specialized on reindeer, six on agriculture, and the remainder on problems of industrial biology. In the extreme north, most of the locally produced food appears to come from state farms, of which there were 70 in 1940. Twenty-eight of these were devoted to breeding reindeer; the remainder concentrated on the production of vegetables, cattle, or cereals. All farms seem to grow some grains. The largest farms are the "Polyarnyy" at Igarka and the "Industriya" at Kirovsk. The total sown area, which was

[41] *Sovetskaya Arktika*, No. 11 (1937) pp. 18, f.; No. 2 (1938) pp. 15-8: "P.O.S." and "P.P.S." appear to be "promyslovo-okhotnich'ya stantsiya" and "promyslovo-proizvodstvennaya stantsiya", or "hunting-production stations", a sort of subarctic variant of the Machine-Tractor Stations (M.T.S.), which are characteristic of the collectivized agriculture of the U.S.S.R.

[42] Khrapal', A., 'Sel'skoye Khozyaystvo Aziatskogo Severa', 1940, p. 128.

[43] *Soviet Weekly*, 10 April 1947.
Soviet Monitor, 2 April 1947.

43,850 hectares in 1926, rose to 257,581 hectares in 1937, and to about 350,000 hectares in 1949. Of this total, the state farms accounted for over 250,000 hectares.[44] Hot-beds are in general use (over 25,000 frames in 1938), and there are hot-houses on Ostrov Diksona, at Bukhta Tiksi and at Bukhta Provideniya.

III

From the existing data, it is impossible to make more than a rough estimate of the past growth and present size of the population of the Soviet Arctic and Subarctic. The following table gives a crude indication of the situation north of 60°N.[45] in 1926 and 1939, the two years for which some census material is available. Figures for 1947 have been added from a recent estimate by Theodore Shabad.

	1926	1939	1947[55]
European North			
Murmanskaya Oblast'	23,006[46]	291,200[48]	450,000
Karelo-Finskaya A.S.S.R.	269,734[46]	469,000[48]	600,000
Arkhangel'skaya Oblast'	429,184[46]	1,199,000[48]	1,050,000
Komi A.S.S.R.	207,302[46]	319,000[48]	450,000
Vologodskaya Oblast'	500,000[47]	800,000[47]	750,000
	1,429,226	*3,078,200*	*3,300,000*
Siberia			
Western Siberia	55,784[49]	115,000[52]	150,000
Central Siberia	60,000[50]	120,000[53]	120,000[56]
Yakutskaya A.S.S.R.	289,085[46]	401,000[48]	450,000
Soviet Far East	35,000[51]	100,000[54]	190,000
	439,869	*736,000*	*910,000*
Total	1,869,095	3,814,200	4,210,000

[44] Khrapal', A., 'Sel'skoye Khozyaystvo Aziatskogo Severa', 1940, pp. 102, 111. *Moscow Radio*, 11 November 1947.
One hectare equals 2.47 acres.

[45] A portion of the Yakutskaya A.S.S.R. lies south of 60°N. Figures for the whole of the Yakutskaya A.S.S.R. are included in the table, as is generally the practice of Soviet writers.

[46] 1926 Census.

[47] Since the 60°N. parallel divides this *oblast'* into two almost equal parts, and the population is distributed relatively smoothly throughout the *oblast'*, the total population given in the Census has been approximately halved.

[48] 1939 Census.

[49] *Sovetskaya Arktika*, No. 11 (1937) p. 137.

[50] An estimate based on data given by Lamont, C., 'The peoples of the Soviet Union', 1946, p. 213, and allowing for the subsequent growth of Igarka, Dudinka, and Noril'sk.

[51] Based on Lorimer, F., 'The population of the Soviet Union: history and prospects', 1946, p. 70.

[52] Based on an estimate of 113,255 for 1937, *Sovetskaya Arktika*, No. 11 (1937) p. 137.

[53] An estimate allowing for the growth of Igarka, Dudinka, and Noril'sk.

[54] Based on an estimate by Lorimer, F., 'The population of the Soviet Union: history and prospects', 1946, p. 166.

[55] From Shabad, T., 'Geography of the U.S.S.R., a regional survey', 1951.

[56] Shabad estimates only 25,000 for the Taymyrskiy and Evenkiyskiy *natsional'nyye okrugi* (each), and only 25,000 for Noril'sk. He does not estimate the population in the remainder of the Krasnoyarskiy Kray north of 60°N. The 1939 estimate has therefore been retained.

With these figures may be compared Soviet statements that:

a) The population of the "Far North" in 1931 was about 1,000,000.[57]
b) The "Far North" in 1939 contained about 2,500,000 people.[58]
c) The Soviet North, "lying between Finland and the Pacific", by which is meant presumably that part of the U.S.S.R. lying north of 60°N., contained about 4,000,000 people in 1939.[59]

Some impression of the pace and nature of this growth may be derived from the following table showing the population of a number of arctic and subarctic settlements.

Murmansk	1926:	8,777[60]	Ostrov Diksona	1937:	100[72]
	1940:	160,000[61]		1944:	200[73]
Kirovsk	1930:	5,000[62]	Igarka	1928:	43[74]
	1944:	150,000[63]		1941:	30,000[75]
Monchegorsk	1935:	(founded)	Noril'sk	1935:	(founded)
	1938:	36,000[64]		1944:	30,000[75]
Petrozavodsk	1926:	47,361[60]	Yakutsk	1934:	23,000[76]
	1939:	91,678[65]		1944:	50,000[77]
Arkhangel'sk	1926:	76,774[60]	Sangar	1936:	130[78]
	1939:	281,091[65]		1940:	3,000[79]
Nar'yan Mar	1926:	5,200[66]	Verkhoyansk	1934:	4,000[76]
	1936:	7,000[67]		1944:	5,000[80]
Vorkuta	1936:	1,000[67]	Anadyr'	1934:	1,000[76]
	1947:	30,000[68]		1937:	1,250[76]
Amderma	1932:	(founded)	Magadan	1928:	(founded)
	1937:	2,000[69]		1947:	70,000[81]
Salekhard	1926:	1,872[70]			
	1938:	10,000[71]			

[57] Taracouzio, T. A., 'Soviets in the Arctic', 1938, p. 455.
[58] Khrapal', A., 'Sel'skoye Khozyaystvo Aziatskogo Severa', 1940, p. 6.
[59] *Soviet Weekly*, 13 February 1947.
[60] 1926 Census.
[61] *Polarforschung*, No. 2 (31 December 1940) p. 2.
[62] *Sovetskoye Olenevodstvo*, No. 4 (1935) p. 111.
[63] Gregory, J. S., and D. W. Shave, 'The U.S.S.R., a geographical survey,' 1944, p. 278.
[64] *Izvestiya*, 18 April 1936.
[65] 1939 Census.
[66] *Trudy Polyarnoy Kommissii*, No. 29 (1936) p. 33.
[67] *Trudy Polyarnoy Kommissii*, No. 30 (1937) *see* Nenetskiy Natsional'nyy Okrug.
[68] *Polarforschung*, Vol. 2 (1947) p. 81.
[69] *Sovetskaya Arktika*, No. 9 (1937) p. 97.
[70] *Sovetskaya Arktika*, No. 5 (1937) p. 79.
[71] *Izvestiya*, 8 February 1938.
[72] *Sovetskaya Arktika*, No. 10 (1937) p. 89.
[73] Gregory, J. S., and D. W. Shave, 'The U.S.S.R., a geographical survey', 1944, p. 304.
[74] *Sovetskaya Arktika*, No. 3 (1935) p. 24.
[75] *Anglo-Soviet Journal*, Vol. 2, No. 2 (1941) pp. 125, ff.
[76] *Sovetskaya Arktika*, No. 7 (1937) p. 85.
[77] Lamont, C., 'The peoples of the Soviet Union,' 1946, p. 133.
[78] *Sovetskaya Arktika*, No. 7 (1937) pp. 67, f.
[79] *Sovetskaya Arktika*, No. 6 (1940) pp. 71, f.
[80] Gregory, J. S., and D. W. Shave, 'The U.S.S.R., a geographical survey', 1944, p. 243.
[81] Dallin, D. J., and B. Nicolaevsky, 'Forced labour in Soviet Russia', 1947, p. 132.

The tempo of growth is obviously too great to be explained by natural increase, and must be ascribed to in-migration.[82] Nor can it be explained by voluntary resettlement, consequent on a wide response to new economic opportunities. First, an ample labour market existed in more temperate, more attractive regions.[83] Second, since the establishment of the All-Union Migration Committee in 1925, government policy for free migration has been concerned almost exclusively with stimulation of the flow to new farming areas beyond the Urals, that is, to southern Siberia. In the Subarctic, resettlement on the basis of agriculture in general is impossible; nor does the literature on the subject contain any program for free northward movement, except to the southeastern portions of the European North. Until the latter half of the Second Five-Year Plan, subsidized and directed migration actually declined;[84] but in the Subarctic, growth appears to have remained fairly steady, if not to have intensified, after the middle 'thirties. This was a period when the G.U.S.M.P. began to pay more attention to its continental enterprises, and when both party and government began an intensive effort to achieve an efficient distribution of labour throughout the country. The latter culminated in 1936 in the delegation to the N.K.V.D. (now the M.V.D.) of the responsibility for colonization.

Between 1926 and 1939, the greatest increase in urban population in the U.S.S.R. took place in the sparsely settled regions north of continuous Russian settlement and east of the Volga.[85] The classification of a community as "urban" by Soviet demographers is based on its economic function, and does not denote a specific size or density of population. Moreover, it appears that any prison camps, operated by the M.V.D., containing 3,000 or more inmates are included in this class. Most of the locations of these camps reported by Dallin's sources lie in the region of maximum urban growth and consistently coincide with the districts of intensive development in the Subarctic.[85]

It is therefore concluded that a very high percentage of the labour-force in the Subarctic has been supplied by enforced migration. How much of this force consists of strictly regimented prison labour, it is impossible to say, since not enough information is available on the nature and number of sentences imposed by court and administrative orders. Certainly, since 1926, the industrial labour-force has been augmented by the commitment of persons whose liberty has been restricted by the state in lumbering, mining, industrial and engineering projects, particularly in

[82] Cf. Lorimer, F., 'The population of the Soviet Union: history and prospects', 1946, pp. 148, 169.
[83] Dobb, M., 'Soviet economic development since 1917', 1948, p. 241.
[84] Lorimer, F., 'The population of the Soviet Union: history and prospects', 1946, p. 172.
[85] Dallin, D. J., and B. Nicolaevsky, 'Forced labour in Soviet Russia', 1947, pp. 51-84.

remote areas.[86] In an inaccessible region, where the delivery of heavy equipment, even if in good supply, is extremely difficult, the value of cheap, mass manpower is obvious. The construction of the Stalin Canal from the Baltic to the White Sea is a familiar example of the use of prison labour. The Tuloma hydro-electric power station was thus built,[87] and *Dal'stroy* appears to be an integral trust of the M.V.D., operating largely with forced labour. Soviet writers have referred to the use of *Ispravitel'nyye Trudovyye Rabochiye* (Corrective Labour) at Amderma and Igarka. Again it seems very likely that the Vorkuta mines may be operated by the M.V.D. It is therefore probable that the assignment of prison labour to the Subarctic has been a very important factor in the growth of the population of the region.

On the other hand, probably all of the directional and operational staffs of the G.U.S.M.P. have been recruited from free labour. By the middle of the Second Five-Year Plan, the core of this organization consisted of 35,000 to 40,000 men, and it employed a further 100,000.[88] In 1936, the staffs of its polar stations totalled 572 men; in 1937, this figure rose to 623.[89] The remainder of the free labour in the Subarctic consists of resident trappers and fishermen who have been organized in the machinery of the cooperatives. Natives appear to make up the bulk of this group.

It is not clear how many of the group of free workers have voluntarily sought work in the "Far North". Even before the decree of 1940, which authorized the direction of labour throughout the U.S.S.R., there appears to have been considerable compulsory assignment to work in the region. Many of those "commandeered" for the supply and trade organizations of the "Far North"(who amounted to 90 per cent of the total employed in these branches), were found unsuitable for such service.[90] Since the end of the war, *Dal'stroy* has advertised for a surprising variety of metallurgical specialists and workers for its enterprises in the Far Northeast.[91]

The reduction of labour costs, the increase of labour productivity, the development of equitable wage-scales, and the application of incentives for this group of free workers have been serious problems. Since the decree of 10 May 1932, special rates of pay and privileges have been granted to workers in the "Far North".[92] The trade union of the

[86] Lorimer, F., 'The population of the Soviet Union: history and prospects', 1946, pp. 172, f.

[87] *Pravda*, 4 November 1936.

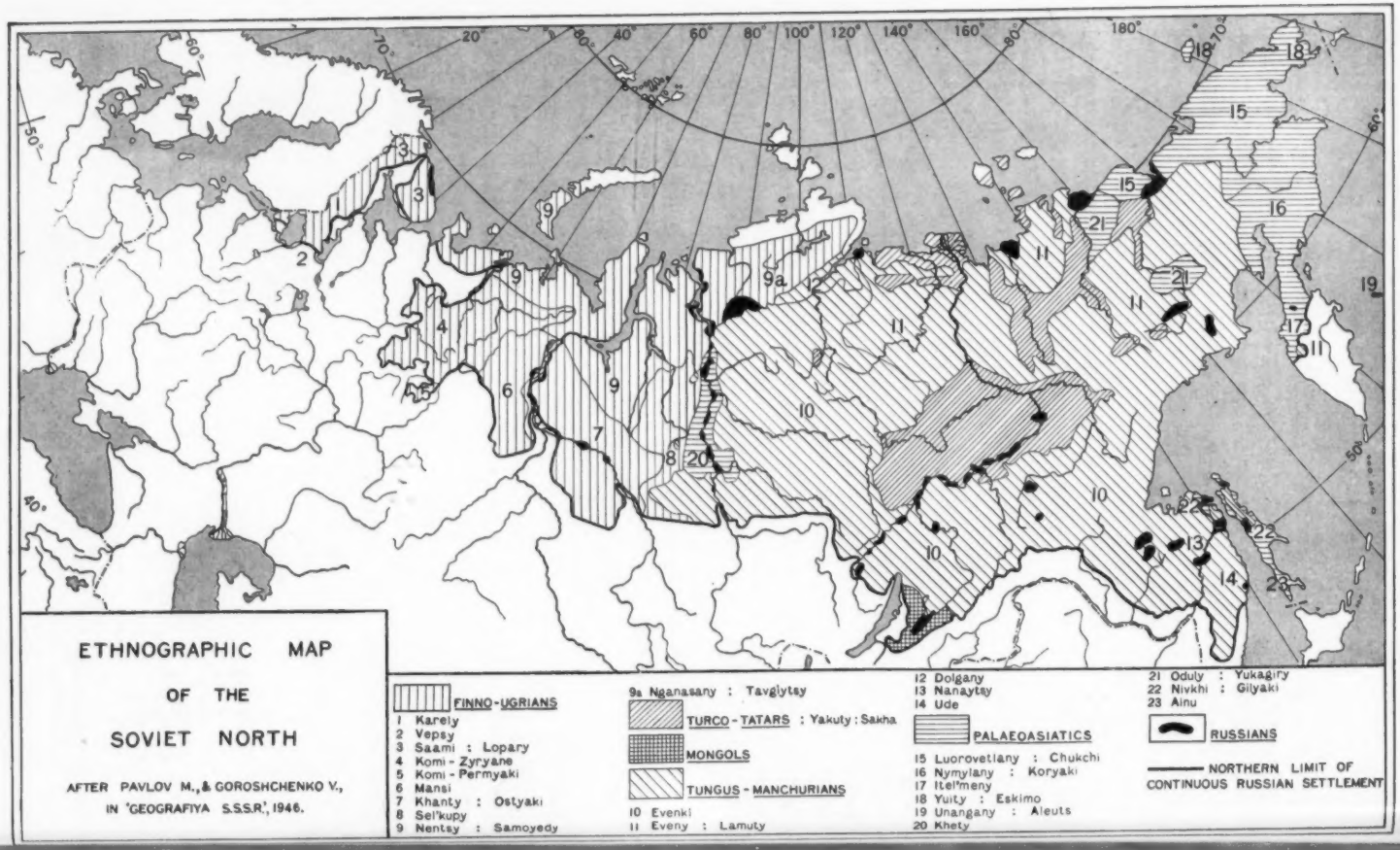
[88] *Sovetskaya Arktika*, No. 1 (1935) p. 18.
Byulletin' Arkticheskogo Instituta, No. 4 (1936) p. 11.

[89] *Problemy Arktiki*, No. 2 (1937) p. 182.

[90] Kantor, Ye., "Kadry v Kraynem Severe", *Sovetskaya Arktika*, No. 2 (1935) pp. 26-9.

[91] *Izvestiya*, 21 May 1938; *Trud*, 6 February 1947 and 23 April 1947; *Vechernyaya Moskva*, 20 February 1947; *Pravda Ukrainu*, 12 March 1947.

[92] Taracouzio, T. A., 'Soviets in the Arctic', 1938, App. XXXIII, pp. 491, ff.


ETHNOGRAPHIC MAP
OF THE
SOVIET NORTH
AFTER PAVLOV M., & GOROSHCHENKO V.,
IN 'GEOGRAFIYA S.S.S.R.', 1946.
FINNO-UGRIANS
1 Karely
2 Vepsy
3 Saami : Lopary
4 Komi - Zyryane
5 Komi - Permyaki
6 Mansi
7 Khanty : Ostyaki
8 Sel'kupy
9 Nentsy : Samoyedy
9a Nganasany : Tavgiytsy
TURCO-TATARS : Yakuty : Sakha
MONGOLS
TUNGUS-MANCHURIANS
10 Evenki
11 Eveny : Lamuty
12 Dolgany
13 Nanaytsy
14 Ude
PALAEOASIATICS
15 Luorovetlany : Chukchi
16 Nymylany : Koryaki
17 Itel'meny
18 Yuity : Eskimo
19 Unangany : Aleuts
20 Khety
21 Oduly : Yukagiry
22 Nivkhi : Gilyaki
23 Ainu
RUSSIANS
NORTHERN LIMIT OF CONTINUOUS RUSSIAN SETTLEMENT

G.U.S.M.P., formed in 1936, has introduced stakhanovism and "socialist emulation", and has initiated measures to improve working and living conditions. But, until 1939, little progress had been made towards the evolution of a fair and systematic wage policy,[93] and the high wage-bill in the enterprises of the Subarctic remained a serious problem.[94]

The pace of the development of the Subarctic has long outstripped the supply of specialists of all kinds. The Arctic Institute and various departments of the G.U.S.M.P. have been responsible for most of the training of technical personnel, which has been centred at Moskva, Leningrad, and Arkhangel'sk. The few women who have found employment in the Arctic appear to have been absorbed largely into scientific and technical "cadres". By 1937, there were 71 in the polar stations,[95] and about 150 were reported in 1940 to be employed at the Peleduy ship-yard on the Lena.[96] Local trades training has been organized by various enterprises. It was estimated that the demand for specialists and tradesmen in the G.U.S.M.P. by 1937 would reach 1,000 technicians and 9,000 tradesmen.[97] As late as 1938, technical personnel were being employed with only three to four years of junior secondary school training, followed by seven to nine months of tuition in courses for mechanics, radio-technicians, and "geophysicists" (meteorologists, surveyors, etc.)[98] The "Far North" has also been very short of less highly trained labour. It was anticipated that the shortage of labour would continue to become more acute during the Third Five-Year Plan, even assuming substantial success in the mechanization of the industries of the region. At the outset of the plan, even the timber trust, *Onegoles*, which operates as close to civilization as in the European North, was able to recruit only 1,100 workers, out of a required total of 11,000; and the Northern River Steam Shipping organization was under-staffed by 2,500 men.[99] It is unlikely that the supply of free labour to the "Far North" has greatly improved.

For centuries, over 20 small minorities, which Soviet ethnographers still find it convenient to group only linguistically, have inhabited the Soviet North. To say what has happened to the numbers of these peoples, in the face of a considerable Russian in-migration, is impossible. Each of the last three censuses taken in the U.S.S.R. (1897, 1926, and 1939) has attempted to include these people. As yet, however, after more than

[93] *Sovetskaya Arktika*, No. 7 (1940) pp. 27-9.

[94] Various writers state that the cost of labour in the "Far North" is twice that in temperate regions. In the Kol'skiy Poluostrov, this is stated to be 80 per cent higher than in the settled regions of the European U.S.S.R. (Brodskiy, A., "Metallurgicheskiy Kombinat Severo-Zapada", *Tekhnika-Molodyozhi*, No. 6 (1947) pp. 15-8.

[95] *Sovetskaya Arktika*, No. 4 (1937) p. 57.

[96] *Sovetskaya Arktika*, No. 1 (1940) p. 96.

[97] *Sovetskaya Arktika*, No. 8 (1937) pp. 68, f.

[98] *Sovetskaya Arktika*, No. 8 (1939) pp. 21-4.

[99] *Izvestiya*, 4 April 1937.

thirty years of the Soviet experiment in the North, no clear picture has emerged. In part, this fact is undoubtedly due to the tremendous difficulties of organizing a reliable machinery for counting small numbers of illiterate and nomadic peoples dispersed over thousands of square miles of wilderness. In part, it is also due to inaccurate and unsystematic classifications inherited by the Soviet government, clarification of which will probably require more field work. In part, this fact may be due to the government's embarrassment over a failure to arrest the decline in the numbers of these people. Because of changes in approach and in classification of these minorities, the 1897 census cannot be compared, for our present purposes, with that of 1926. Even the latter was disappointing, in that it embraced only 16,282 households out of a total of about 25,000 then living north of the Arctic Circle.[100] For the period between 1926 and 1939, such data as have appeared are ambiguous.[101] A census of the "Far North" attempted in 1937 was suppressed.[102] Finally, the census of 1939 contained no data on either the Buryaty, Yakuty, or the smaller peoples of the North. That Lappo, in 1945, was still quoting the figure of 160,000, which was derived from the 1926 census, as the total number of natives in the "Far North", probably indicates lack of later data.[103]

Of the fourteen minorities mentioned by Lappo, only nine can be more or less clearly identified in the 1926 census. The figures given in each source for these are compared below:

	1926 Census[104]	*Lappo (1945)*[105]
Saami (Lopary)	1,720	1,800
Komi-Zyryane	226,383	(no figure cited)
Nentsy (Samoyedy)	15,462	15,000
Khanty (Ostyaki)	22,306	22,000
Entsy (Yeniseyskiye Samoyedy)	—	400
Dolgany	656	"negligible"
Nganasany (Tavgiytsy)	—	600
Evenki	37,546	40,000
Yakuty (Sakha)[106]	240,709	250,000
Eveny (Lamuty)	—	12,000
Oduly (Yukagiry)	—	450
Etely (Chuvantsy)	—	700
Luorovetlany (Chukchi)	12,332	12,000
Yuity (Eskimo)	1,293	1,300

[100] *Sovetskiy Sever*, No. 2 (1933) pp. 39-51.

[101] Lorimer, F., 'The population of the Soviet Union: history and prospects', 1946, p. 137.

[102] Vagonov, A., "Perepis' Naseleniya Kraynego Severa", *Sovetskaya Arktika*, No. 7 (1939) pp. 10-4.

[103] Lappo, S. D., 'Spravochnaya Knizhka Polyarnika', 1945, p. 341.

[104] Lorimer, F., 'The population of the Soviet Union: history and prospects', pp. 55, 60.

[105] Lappo, S. D., 'Spravochnaya Knizhka Polyarnika', 1945, p. 344-52.

[106] In general, Soviet ethnographers prefer the nomenclature used by the minorities. The older names by which these peoples have been known are given in brackets; an exception is the Yakuty, who call themselves "Sakha".

Lappo's figures suggest a slight increase in the numbers of Saami, Evenki, Yakuty, and Yuity. The total numbers of Nentsy in 1926 are probably to be compared with Lappo's totals for the Nentsy and Entsy combined. Similarly, the Dolgany and Nganasany were probably not differentiated in 1926. Even so, a decline in numbers is suggested for the Nentsy, Khanty, Dolgany, and Luorovetlany, although the possibility remains that this apparent decline may be explained by re-grouping.

At least until the outbreak of the Second World War, the notion of the ultimate use of the natives of the "Far North" as pilots, navigators, zoologists, fur factory managers, teachers, and party officials, seems to have persisted. One or two races, especially the Yakuty, showed particular aptitude. The government has long realized that the training of native labour for use in the new economic machinery of the North is a project requiring many years and a comprehensive program of native education and welfare. It has attempted to combine with the economic functions of the native cooperatives the role of educational centres improving the simpler techniques of forest economy. At the same time, a federal teaching machinery has been established, centred on the Institute of the Peoples of the North (Leningrad), spreading out through some dozen normal schools, 500 primary and secondary schools,[107] and reinforced by many local newspapers, cinemas, and libraries.[108]

Prior to 1940, however, the numbers of natives actually trained and employed in the "Far North" represented only a small fraction of the total labour force. The G.U.S.M.P. was accused of having made little effort to draw these people into its enterprises, and only a small portion of its annual appropriation for technical training of natives was in fact invested.[109]

The actual increase in population in the Soviet Subarctic forms only a small percentage of the total increase in the U.S.S.R., but its importance lies in the fact that it represents the expansion of settlement into an inclement and hitherto undeveloped region. Although the northward movement is the smallest of the great shifts which have taken place during the Plans, it owes its rapidity to the search for exportable and scarce raw materials, and to that tendency in Soviet economy to give priority of consideration to productivity rather than to marginal costs. It is claimed that the growth of population in the North has already contributed greatly to the reduction of the numbers in the ten over-populated districts of old central Russia.[110]

[107] *Sovetskaya Arktika*, No. 11 (1937) pp. 44, ff. *Soviet News*, 8 September 1948.

[108] There were 22 newspapers published in the "Far North" in 1940 (G.U.S.M.P., 'Pechatnyye Gazety Arktiki / Sbornik', 1940, p. 6.)

[109] *Sovetskaya Arktika*, No. 7 (1938) pp. 36, f.

[110] These are the Ryazanskaya, Orlovskaya, Voronezhskaya, Tambovskaya, Penzenskaya, Kuybyshevskaya, Kalininskaya, Smolenskaya, Yaroslavskaya, and Vologodskaya *oblasti*, and the Mordovskaya A.S.S.R. (*Bol'shaya Sovetskaya Ensiklopediya*, Tom "S.S.S.R.", 1948, p. 55).

BOTANICAL INVESTIGATIONS IN SOUTHWEST GREENLAND, 1946

By Tyge W. Böcher*

FOUR Danish botanists took part in the Botanical Expedition to West Greenland in the summer of 1946. Morten Lange was the mycologist, M. Skytte Christiansen the lichenologist, Kjeld Holmen the bryologist, and the writer was responsible for collecting vascular plants and fresh water algae and for making analyses of the vegetation and measurements of the environmental factors.

The expenses of the expedition were paid by the Carlsberg Foundation and further assistance was given by the Royal Danish Navy and the Grønlands Styrelse. The American authorities at the Bluie West 8 airbase in Søndre Strømfjord placed a house at our disposal, where we were able to set up a laboratory for microscopic work and handling of the material collected.

Our investigations concentrated on three areas: Arsuk Fjord, Godthaab, and Søndre Strømfjord. At the last place we spent a little over one month, and from our headquarters at the airbase we made several fairly long excursions, such as to the edge of the ice cap and into the Ørkendalen, an extensive valley with desert-like areas of drift sand. The edge of the ice cap is stagnant in this region; no oscillations of any importance have occurred for a long time, and the vegetation extends right up to the lateral moraines and river beds in front of the ice wall (*see* Figs. 2 and 3, also further details in Böcher 1949 a).

In the Søndre Strømfjord region the main areas studied lay between Itivdlinguaq, midway along the fjord (66°30N.), and the ice front (about 67°N.). Here the climate is continental with desert-like precipitation (a little over 100 mm. annually) and fairly high summer temperatures (about a mean of 10°C in July in the lowland which has an almost subarctic climate). Considerable deposits of loess are conspicuous, especially on south-exposed mountain slopes where the drought prevents the growth of dense vegetation. Xerophilous grasses and sedges are the most important vegetation on these slopes. In several closed basins among the low mountains undrained lakes are a very characteristic feature.

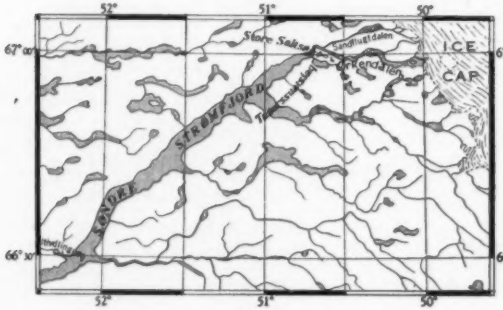


Fig. 1.

*Botanical Institute, University of Copenhagen.

Fig. 2. Members of the expedition leaving the house at the head of Søndre Strømfjord.

Fig. 3. The edge of the ice cap, about 67°N. In the left background the heath vegetation reaches right up to the lateral moraines.

Fig. 4. Large dune formed at the entrance to a small valley leading to the ice cap. In the foreground the low dunes are overgrown by willow.

The water in these is more or less salt and salt crusts on the ground round the lakes are fairly common; the vegetation is strongly affected by the saline, extremely alkaline soil (soil reaction sometimes with a pH of more than 9). One of the salt lakes was particularly interesting. It was surrounded by four clear cut terraces, and on the western side of the lake these consisted of alternating layers of loess and undecayed moss particles of *Drepanocladus aduncus*. The sedimentations are quite large and the terraces show that the climate has gradually become drier. A detailed account of the investigations on the climate and the soil of the region, of the analyses of the water and the salt crust, and of the topographical conditions of the salt lakes has been published (Böcher 1949 b).

Comprehensive vegetation analyses and ecological investigations as well as the greater part of the floristic material have not yet been completed. It can be said though that the flora in the most continental parts of West Greenland differs considerably from that of the coastal mountains.

During the expedition several seed samples were collected and these were later sown in Copenhagen. The plants which appeared as well as some living plants brought back with us were cytologically examined. The material has proved to be very interesting. On the basis of differences in chromosome numbers some species can be further divided. Within the genus *Luzula* a new species can be distinguished which has a deviating number of chromosomes and is morphologically distinct. It occurs in most parts of continental West Greenland and has also been found in Ungava and in Labrador (see Böcher and Larsen 1950; Böcher 1950 b).

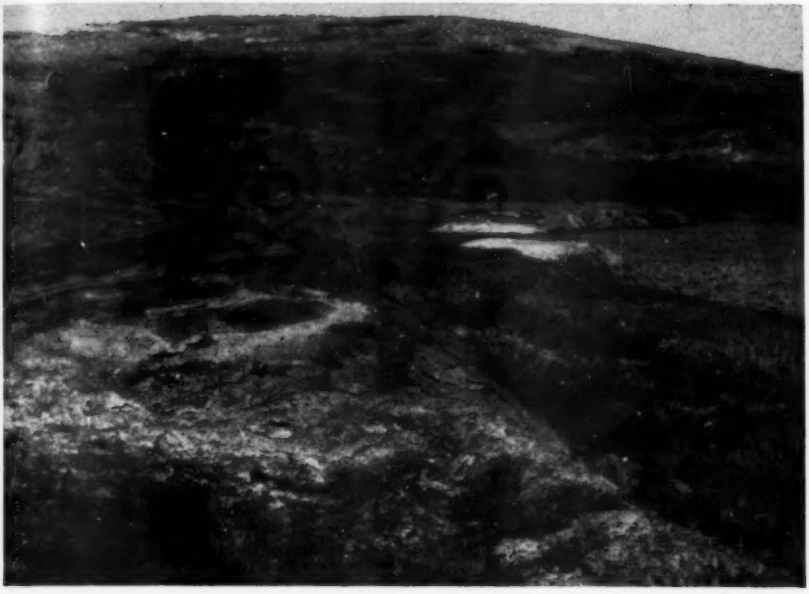


Fig. 5. Støre Saltsø, at the head of Søndre Strømfjord. The lake is surrounded by terraces formed of loess and moss; white salt crusts can be seen on the lowermost terrace.

The finds of *Sisyrinchium montanum* and *Selaginella rupestris* were most interesting as these are both North American species whose northern limits lie just north of Newfoundland (*Sisyrinchium*) or in Nova Scotia (*Selaginella*). The occurrence of these species in Greenland has been dealt with in another paper (Böcher 1948). The many collections of Cryptogamia have not been finally worked up. Morten Lange has published a paper on the Gasteromycetes (1948) and the writer has described some freshwater algae collected in Arsuk Fjord (Ivigtut), which proved to contain a number of hitherto unknown species (Böcher 1950 a).

All the material collected belongs to the Botanical Museum of Copenhagen, and the results are published in the *Meddelelser om Grønland*.

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NOTES ON DANISH SCIENTIFIC WORK SINCE 1939

By A. Noe-Nygaard, C. Vibe, T. W. Böcher, and E. Holtved

Geological Work and the Founding of the Geological Survey of Greenland

In the 'seventies the late Professor F. Johnstrup advocated founding a Geological Survey of Greenland and a Geological Survey of Denmark. While the latter was formed in 1888, it was not until 1946 that a permanent Geological Survey of Greenland was established.

Professor Johnstrup, the founder of *Meddelelser om Grønland*, was the moving spirit of the geological work carried out in Greenland in the last decades of the nineteenth century. At this time a reconnaissance mapping, both topographic and geological, was carried out; the geological work was undertaken by K. J. V. Steenstrup, J. Lorenzen, A. Kornerup, N. V. Ussing, and others. Unfortunately, both Lorenzen and Kornerup died at a very early age, and when Ussing became Professor of Mineralogy in Copenhagen, the first attempt to establish a permanent Geological Survey of Greenland was given up. Since then much geological work has been carried out on numerous expeditions under the auspices of the "Kommissionen for videnskabelige Undersøgelser i Grønland".

Shortly before the Second World War a new attempt to form a Geological Survey of Greenland was made by O. B. Bøggild, K. Jessen, and M. Vahl, professors in the University of Copenhagen, and V. Madsen, then Director of the Geological Survey of Denmark. It was not until 1946 that the matter was raised again and success attained—the new institution was established. During the first five-year period the Survey has been directed by a four-man committee, consisting of Alfred Rosenkrantz, Professor of Geology at the Royal Technical High School in Copenhagen, Arne Noe-Nygaard, Professor of Mineralogy in the University of Copenhagen, Hilmar Ødum, Director of the Geological Survey of Denmark, and the Director of Grønlands Styrelse, at first Knud Oldendow, later Eske Brun.

From 1946-50 the Geological Survey of Greenland (abbreviated to G.G.U.) has worked in the following four regions: northwestern Greenland; southwestern Greenland; south Greenland, and east Greenland. The areas of work are shown on the map on page 53, and the following lists give the members of the G.G.U. field parties. In south Greenland Richard Bøgvad, chief geologist of the Cryolite Company, and his assistants have collaborated with the G.G.U.

Northwestern Greenland	1946	1947	1948	1949	1950
Alfred Rosenkrantz	x	x	x	x	x
Sole Munck	x	x			
Me Mouritzen	x				
Helge Gry	x		x		
Bruno Thomsen	x	x		x	
Dan Laursen	x				
Knud Eriksen	x				
Kristian Skou	x			x	x
Bent Søndergaard	x				
Hilmar Ødum		x			
Viggo Münther		x	x	x	
Inger Margrethe Rasmussen		x	x	x	
Eske Koch		x		x	
Erik Heller		x			
Knud Jakobsen		x	x		x
Sven A. Jensen		x			
Alf Kiilerich			x		
R. P. Sørensen			x		
Sonja A. Hansen			x	x	x
Joannes Rasmussen			x		
Knud Storgaard			x		
Christian Poulsen				x	
Hans Pauly				x	
Tove Birkelund				x	
Arne Buch				x	x
Søren Floris				x	
Valdemar Poulsen				x	x
Lars Jørgen Andersen					x
Stig Bak Jensen					x
Gudrun Thomsen					x
Southwestern Greenland					
Arne Noe-Nygaard	x			x	
Hans Ramberg	x	x	x	x	
Me Mouritzen	x	x			
Hans Pauly	x				
Maagens Maag	x	x			
Eva la Cour	x				
K. Ellitsgaard Rasmussen	x	x	x		
K. Milthers		x			
P. Graff-Petersen		x			
M. L. Ramberg		x	x	x	
Asger Berthelsen		x		x	
Henning Sørensen			x	x	
Mogens Walther				x	

South Greenland	1946	1947	1948	1949	1950
The Cryolite Company:					
Richard Bøgvad	x	x	x	x	x
Henning Sørensen	x	x			
P. Graff-Petersen			x		x
Aage Jensen					x
G.G.U.:					
Arne Noe-Nygaard	x			x	
K. Ellitsgaard Rasmussen	x				
Henning Sørensen				x	
Asger Berthelsen				x	
Mogens Walther				x	
East Greenland					
Christian Poulsen	x				
Eigil Nielsen	x				
H. Wienberg Rasmussen	x				
Eske Koch	x				
Valdemar Poulsen	x				
Johannes Troelsen					x
Gudrun Troelsen					x

In addition to the field parties of the G.G.U. the following geological work has been carried out:

1939-41 Johannes Troelsen, as geologist on the Danish Thule and Ellesmere Land Expedition, studied the geology of northwestern Greenland and Ellesmere and Axel Heiberg islands in the Canadian Arctic.

1945 Alfred Rosenkrantz and Sole Munck worked in east Greenland between 70° and 75°N.

1945 Richard Bøgvad carried out investigations for the Cryolite Company in south Greenland.

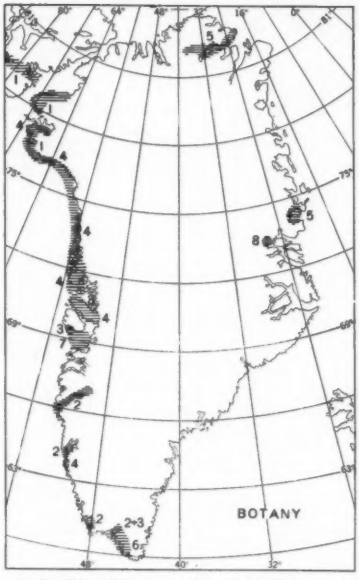
1947-50 Eigil Nielsen, Johannes Troelsen, and K. Ellitsgaard Rasmussen participated in the geological program of the Danish Pearyland Expedition.

1947-8-9 Lauge Koch led expeditions to the Franz Joseph Fjord region of east Greenland in which Swedish, British, and Swiss geologists took part.

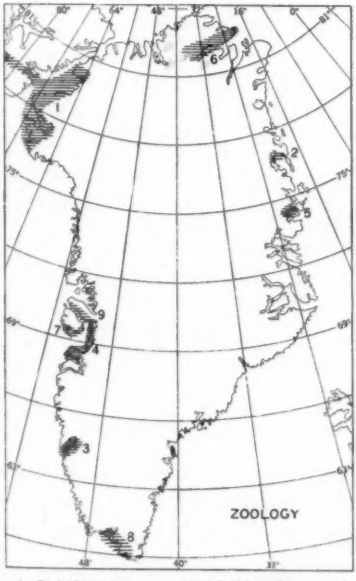
1949 Hilmar Ødum and Bent Søndergaard, accompanied by a group of civil engineers under K. B. Larsen, spent the summer months making a special study of ground water and permafrost problems near Egedesminde, Godthaab, and Narssaq.

ARNE NOE-NYGAARD

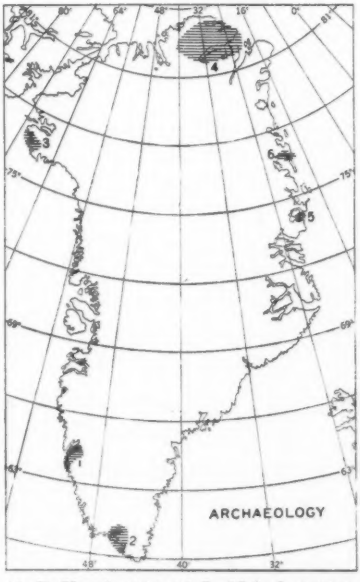
1) J. Troelsen 1939-41; 2) G.G.U. 1946-50; 3) G.G.U. 1946-9; 4) Cryolite Company 1945-50; G.G.U. 1946, 1949; 5) A. Rosenkrantz 1945; G.G.U. 1946; L. Koch 1947-9; Pearyland Exped. 1947-50; 6) Pearyland Exped. 1947-50.



1) G. Thorlaksson 1939-40; 2) Botanical Exped. 1946; 3) Cytogenetic Exped. 1947; 4) K. Jakobsen 1947-8; 5) Pearyland Exped. 1947-50; 6) C. A. Jørgensen, C. H. Bornebush 1948; 7) E. S. Nielsen 1948; 8) F. Schwarzenbach 1949.



1) C. Vibe 1939-41; 2) N. Haarløv 1939-40; 3) C. Vibe 1942-5; 4) F. Salomonsen 1946; 5) and 6) Pearyland Exped. 1947-9; 7) H. Madsen 1948-9; 8) and 9) Zootopographical Investigation 1948-50.



1) E. Knuth 1945; 2) L. Vebæk 1945-6, 1948-50; 3) E. Holtved 1946-7; 4) E. Knuth 1947-50; 5) J. Melgaard 1948; 6) E. Knuth 1950.

Danish scientific work in Greenland, 1939-50

Zoological Work

1939-41 Christian Vibe, as zoologist on the Danish Thule and Ellesmere Land Expedition, studied the fauna and made collections in the Thule district, Inglefield Land, and Washington Land and in Ellesmere and Axel Heiberg islands in the Canadian Arctic. Land and sea mammals, birds, insects, and the bottom fauna of both fresh water lakes and of the sea were examined.

1939-40 Niels Haarløv, as a member of the Danish Northeast Greenland Expedition, studied the microfauna of Mørkefjord, Dove Bugt.

1942-5 Christian Vibe collected insects and freshwater fauna in the Godthaab district.

1946 Finn Salomonsen travelled along the west coast of Greenland to organize an extensive program of bird banding. This work is still being carried on.

1947 Palle Johnsen and Møhl-Hansen carried out zoological work on the reconnoitering party of the Danish Pearyland Expedition.

1948-9 Palle Johnsen, as zoologist, took part in the first wintering of the Danish Pearyland Expedition.

1948-9 Harry Madsen wintered on Disko Ø to carry out ornithological studies, particularly on the adaptation of birds to low temperatures.

1948-50 Grønlands Styrelse began the "Zootopographical investigation of Greenland". This investigation, which is led by Christian Vibe, aims to map the land and freshwater fauna of Greenland, concentrating particularly on the insects and other invertebrates. In 1948 work was started in the Julianehaab district; in 1949 the Nugssuaq Halvø was examined, and in 1950 it was planned that the investigations would be continued in the Godthaab Fjord region. Students from Greenland high schools have been participating in the collecting work.

1949 Finn Salomonsen travelled along the entire coast of West Greenland to supervise the program of bird banding begun in 1946 and to continue mapping the bird colonies.

1949 E. Ursin made zoological collections in Clavering Ø, in northeast Greenland on the Danish Pearyland Expedition.

In addition to these zoological expeditions, annual marine-biological investigations have been carried out by Paul Hansen and Erik Smidt in the fisheries research vessel *Adolph Jensen*, which is permanently stationed in Greenland. Working along the coast of west Greenland Hansen has carried out fisheries investigations and has made a special study of the areas where shrimps are found and the possibilities for developing this fishery.

The Arctic Biological Station on Disko Ø, founded by M. P. Porsild, has been continued. Paul Gelting, who is now responsible for the station, has made a special study of the feeding habits of sea mammals and of protection problems.

CHRISTIAN VIBE

BOTANICAL WORK

1939-40 G. Thorlaksson, a member of the Danish Thule and Ellesmere Land Expedition, made collections and observations of the vegetation in the Thule district.

1946 The Botanical Expedition to West Greenland studied the vegetation of the Søndre Strømfjord region in detail and worked along the coast range of southwest Greenland from 61° to 67°N. The members were: T. W. Böcher (vascular plants, fresh water algae, ecology), M. Skytte Christiansen (lichens), K. Holmen (bryophytes), and M. Lange (fungi). (For further details *see* the paper by T. W. Böcher in this number of *Arctic*, p. 46).

1947 A cytogenetic expedition, led by C. A. Jørgensen, travelled along the west Greenland coast as far north as the Nugssuaq Halvø during the summer to collect vascular plants for chromosome investigations. The other members of the expedition were T. Sørensen, Inger Juhl, and the late Gudni Gudjonsson.

1947-8, and 1950 Knud Jakobsen, a member of the G.G.U. expeditions to northwest Greenland, made large collections of plants and vegetation analyses in the region between the Nugssuaq Halvø and Olriks Fjord.

1947-50 The Danish Pearyland Expedition: K. Holmen wintered in Peary Land in 1948-9 and collected all groups of plants and studied the ecology; M. Westergaard and Hans Mathiesen visited the Zackenberg area in northeast Greenland during the summer expeditions.

1948 C. A. Jørgensen and C. H. Bornebush studied the Greenland birch to obtain data useful for experimental planting of trees.

1948 E. Steeman Nielsen made quantitative examinations of the plankton in Disko Bugt between Disko Ø and the mainland.

1949 F. Schwarzenbach, the Swiss botanist studied the botany of the Franz Joseph Fjord region on the expedition to east Greenland led by Lauge Koch.

Besides the investigations carried out on expeditions much botanical work has been done by the leaders of the Arctic Biological Station on Disko Ø, M. P. Porsild and Paul Gelting.

TYGE W. BÖCHER

Archaeological Work Carried Out by the National Museum

1945 Eigil Knuth carried out archaeological investigations in the vicinity of Godthaab.

1945-6 L. Vebæk excavated Norse ruins in southwest Greenland in 1945. The following year he was joined in this work by O. Voss, as assistant.

1946 J. Troels-Smith, of the bog laboratory of the National Museum, investigated shoreline movements throughout west Greenland.

1946-7 Erik Holtved studied the folklore and archaeological sites in the Thule district.

1947-50 Eigil Knuth, the leader of the Danish Pearyland Expedition, studied the Eskimo sites discovered by this expedition.

1948 J. Melgaard, a member of the Danish Pearyland Expedition, examined Eskimo sites on Clavering Ø, east Greenland.

1948-52 L. Vebæk began a four-year program of work in 1948 during which he hopes to complete his investigations of Norse ruins in southwest Greenland. In 1949 he was joined by J. Melgaard and Sverri Dahl as assistants.

Erik Holtved

THE ALASKAN SCIENCE CONFERENCE

On 9-11 November 1950 an Alaskan Science Conference was held in Washington under the auspices of the National Academy of Sciences-National Research Council. More than 300 scientists, many of whom are Alaskan specialists, attended the Conference at the invitation of the Research Council. The Conference was organized into ten sections in three divisions and each section designated a Resolutions Subcommittee to draft proposed resolutions of interest to that section. The proposals were then reviewed by the entire Conference and were approved, modified, or eliminated. The following resolutions, therefore, represent the final action of the Alaskan Science Conference.

I. General Recommendations

1. *Scientific information centres*

That scientific information centres be established in Alaska and the States to provide information relative to scientific research and to facilitate cooperation between individuals, organizations, and Government agencies concerned with Alaskan scientific research and development in collaboration with the University of Alaska and the Arctic Institute of North America.

2. *Future conferences*

That future scientific conferences relative to Alaska be held, and that they be held in Alaska when feasible.

3. *Establishment of committees*

That the National Research Council establish:

a. Appropriate committees representing interested organizations, formed on a permanent basis for furthering the study of interrelationships of physical, biological, and human factors affecting fisheries, wildlife, forests, etc.

b. A committee on Alaskan anthropology to survey the present needs and possibilities for field research and to act as a clearinghouse and advisory committee to governmental agencies, private institutions, and scientists on problems concerning anthropological research, preservation of antiquities, and native welfare in Alaska.

c. A continuation committee to begin functioning immediately under the chairmanship of John C. Reed to assist the National Research Council in implementing the recommendations of the Conference and to arrange for the early publication of the Conference proceedings.

4. *Exchange of information*

That there be utmost freedom in exchanging Alaskan scientific data in order to stimulate and coordinate research; and to this end the Conference strongly recommends that, insofar as the national interests permit, scientific investigations and their results in Alaska be unclassified and such information as is now classified be made available for general scientific use as soon as possible.

5. *Publication of scientific findings*

That every effort be made to further the publication, in appropriate scientific journals, of reports on systematic, ecologic, and other comprehensive studies in the sciences relating to arctic and subarctic research; and that, where such reports are not appropriate for publication in the journals, funds be secured for their publication as special monographs or reports.

6. *Field research centres*

That the feasibility be explored of establishing in Alaska specialized research centres for:

a. Subarctic marine investigations;
b. Wildlife research (nonmarine);
c. Studies in forestry;
d. A permanent research establishment for public health and medicine, such as the proposed Arctic Health Institute;
e. Studies of snow, glacier ice, and sea ice in the temperate, subarctic, and arctic zones of Alaska and adjacent areas.

In the event that the establishment of such specialized research centres does prove feasible, active steps to start them should be undertaken without delay, and when possible such centres should be established in close proximity to and in working relationship with the University of Alaska.

7. *Aids to maximum utilization of existing and planned facilities*

a. That well-coordinated, long-range, year-round research programs in arctic and subarctic studies at universities be encouraged, such as those programs in operation at the University of Alaska, the University of Washington, the University of Minnesota, and the Catholic University of America.
b. That agencies responsible for the planning and support of research programs in Alaska be reminded of the need for continued long-term studies extending over sufficient cycles of pertinent natural phenomena, as well as for suitably planned short-term investigations, and be urged therefore to provide for continued work of adequate duration.
c. That as part of the mechanics of staffing research in the several fields of science involved, arrangements be made for research fellowships at varying financial grades for competent graduate students and for grants-in-aid to established scholars, including local inhabitants of Alaska; that applicants for such fellowships or grants-in-aid be carefully screened for scholarly competence and suitability for Alaskan work.
d. That Federal agencies, foundations, and universities be encouraged to participate in Alaskan research, with emphasis on the value of interdisciplinary research.
e. That the military services be encouraged to further promote and assist scientific studies in line with their operational duties in the Alaskan areas, and that the research of nonmilitary Federal services be expanded in order that the potentialities of Alaska may be realized and its defence fostered.
f. That Federal aid to research be continued and expanded through such means as the programs of the Pittman-Robertson bill and the Office of Naval Research.
g. That the needs of and opportunities for Alaskan research be brought to the attention of the National Science Foundation.

8. *Conservation*

That studies be made to determine what areas in Alaska are suitable for designation as wildlife habitat combined with wilderness uses, from which shall be excluded uses incompatible with such purposes, such as private holdings, highways, etc. Specific projects would include critical caribou ranges to be kept as wilderness areas and certain waterfowl breeding areas.

II. Recommendations Pertaining to International Cooperation

1. That, when appropriate, scientists of other nations be encouraged to participate in field operations in Alaska. The value of this type of cooperative research has

been and is being thoroughly demonstrated in joint Canadian-United States research activities.

2. That, in carrying out the recommendations of this Conference, the National Research Council collaborate actively with the Arctic Institute of North America, which has contributed so effectively to arctic research.

III. Specific Recommendations

1. *Agricultural land-use planning*

That the appropriate agency or agencies, in order to facilitate the planning and settlement of available arable lands, be urged to continue and extend the survey and classification of soils and environments in those areas deemed most promising for potential agricultural development.

2. *Development of vegetation and of soils*

That comprehensive studies be made of agricultural climatology as well as of the development of vegetation and of soil on recent surfaces, or potential soils exposed at known or discoverable dates, for which study Alaska presents exceptional opportunities.

3. *Botanical exploration*

That attention be called to the many botanically unexplored regions in Alaska in which extensive and intensive collecting needs to be done, for example, in the regions of the Brooks Range, Kuskokwim Basin, the interior of the Seward Peninsula, and the Alaska Range, and furthermore that systematic work on cryptogams be strongly encouraged.

4. *Vegetation and frost action*

That the importance of field studies on the vegetation of Alaska in relation to frost action in the soils be emphasized because of its bearing upon the structure and development of the vegetation, and through these, upon road and railroad building, air fields and other military installations, water-supply systems, sewage and garbage disposal, construction sites, and development of agricultural and range lands.

5. *Vegetation and animal life*

That other field studies of vegetation in Alaska, in relation to utilization by domestic and wild animals, be encouraged.

6. *Plant sciences*

That field research in plant physiology, anatomy, cytogenics, and other plant sciences be carried on in Alaska. This will require mobile or temporary laboratories adequately equipped.

7. *Environmental health and sanitation*

That studies be initiated, and, if already underway, be intensified in the following sanitation problems under low-temperature conditions, and that these studies be directed toward obtaining information that can be used to assist and protect both civil and military populations of Alaska, including very small and isolated groups of individuals.

a. Water supplies–feasible methods of attaining and maintaining safe water supplies.
b. Water pollution–studies necessary of both inland and coastal waters.
c. Sewage, excreta, and garbage disposal.
d. Insect control–studies on the species, flight range, breeding habits, etc., of mosquitoes and other biting insects to develop feasible control measures.
e. Housing.

8. *Life histories*

That research on the life histories of Alaskan wildlife species be encouraged through the Fish and Wildlife Service, universities, and other agencies.

9. *Habitat changing factors*

That cooperative research programs which involve the effect of fire, logging, and other habitat-changing factors on wildlife be augmented.

10. *Applied physiology*

That the maintenance of a broad research program should include primarily the fundamental studies which form the basis for applied physiology and should also include intensive studies on problems immediately related to agriculture and animal husbandry, fisheries, industries, general medicine, public health, preventive medicine, and military medicine.

11. *Geophysical Institute*

That the Conference express to the Delegate to Congress from Alaska, to the Government of Alaska, and to the Regents and President of the University of Alaska its gratification at the establishment of a Geophysical Institute at the University and the development of a comprehensive program of training and investigation in geophysical subjects of unique importance to Alaska.

12. *High altitude cosmic ray studies*

That full advantage be taken of the unique combination of high mountains at high latitudes, in furthering cosmic ray studies.

13. *Publication of weather data*

That additional publication be made of comprehensive basic weather and climatic data which are necessary for research, for governmental projects, and also for the use of private enterprise in developing the resources of Alaska.

14. *Ice islands*

That advantage be taken of the large ice islands in the Arctic Ocean to establish scientific field bases for operations extending over adequate periods of time.

15. *Climatic change*

That questions of climatic change in Alaska, both in the recent past and the near future, be investigated through studies dealing with such subjects as the advance and retreat of glaciers, botanic distributions by pollen analysis, etc., and permafrost, as well as through climatic and meteorological analysis.

16. *Mapping*

That current mapping programs for Alaska, including topographic and planimetric mapping, charting of coastal waters, aerial photography, and geodetic surveys be speeded up in order to provide as rapidly as possible the basic map information essential to natural-resource surveys, scientific research, national defence, and economic development.

17. *Geological investigations*

That geologic mapping and other investigations in the geologic field be continued and expedited to contribute to more adequate understanding of the basic geology of the Territory.

18. *Archaeological sites*

That more active and effective measures be taken to preserve archaeological sites in Alaska, many of which are now being destroyed despite provisions of the Antiquities Act of 1906.

IV. Final Resolutions

1. *Nonmilitary support of research*

That the Conference express its appreciation for the support of scientific research in Alaska, particularly by the following nonmilitary Government or Government-associated agencies: the Department of the Interior, the Department of Agriculture, the Department of Commerce, the Public Health Service, the United States Coast Guard, and the Smithsonian Institution.

2. *Military support of research*

That the Conference express to the Department of Defense its deep appreciation for the support being given to a wide range of scientific investigations in Alaska, for example, that being rendered by the Office of Naval Research through the Arctic Research Laboratory at Point Barrow.

3. *Territorial support of research*

That the Conference express to the Territory of Alaska its appreciation for research being carried on under Territorial auspices and for the active support being given to research by the University of Alaska.

4. *Support of the Conference*

That the Conference express its appreciation to the National Academy of Sciences-National Research Council, the Department of the Interior, the Department of Agriculture, the United States Army, the United States Navy, the United States Air Force, the Public Health Service, and to the Arctic Institute of North America for providing essential facilities and financial assistance which were major factors in making the Conference possible.

RECENT STUDIES ON VITAMINS

VITAMIN SOURCES IN ARCTIC REGIONS. *By* KAARE RODAHL. *Oslo: Norsk Polarinstitutt, Skrifter 91, 1949. 10¼ x 6¾ inches; 64 pages; illustrations and map. Swedish kroner 6.00.*

THE TOXIC EFFECT OF POLAR BEAR LIVER. *By* KAARE RODAHL. *Oslo: Norsk Polarinstitutt, Skrifter 92, 1949. 10¼ x 6¾ inches; 90 pages; diagrams and illustrations. Swedish kroner, 12.50.*

HYPERVITAMINOSIS A. *By* KAARE RODAHL. *Oslo: Norsk Polarinstitutt, Skrifter 95, 1950. 10¼ x 6¾ inches; 206 pages; diagrams and plates. Swedish kroner, 22.50.*

Three of the recent papers in the "Skrifters" published by the Norsk Polarinstitutt deal with studies on vitamins and will be of interest to all arctic scientists and explorers. These papers were written by the Norwegian scientist Kaare Rodahl, who has participated in a number of scientific expeditions to the Arctic during the past ten years and has studied many of the nutritional problems peculiar to these regions.

The first two papers contain some of the results of Dr. Rodahl's research carried out on three expeditions: in northeast Greenland on a wintering expedition in 1939-40; on the Newfoundland seal fishery in 1941; and in Peary Land, as a member of the reconnoitering party of the Danish Pearyland Expedition in 1947. The third considers the results of laboratory experiments designed to verify some of the points raised in the second paper.

The first paper deals with the vitamin sources in the arctic regions. In the first part Dr. Rodahl describes his investigations of the vitamin A content of the liver of the hooded seal (*Cystophora cristata*) and the harp seal (*Phoca groenlandica*). Over 10,000 livers from these two species were collected and assayed for vitamin A. The livers were found to have a fairly high vitamin A potency (mean value: 3,000-3,400 I.U. vitamin A per gram liver), and the values were of the same order in both species with similar variations when age and sex were taken into consideration. A seasonal variation in vitamin A content of the livers was observed; this could be explained by the feeding habits of the seal during breeding.

In the second part of the paper Dr. Rodahl gives the results of studies on the vitamin C content of the most common mammals, fishes, and birds of northeast Greenland; his work on the common plants of the same region was published in an earlier paper.[1] Liver, brain, kidney, and other internal organs of the musk ox and seal were found to be rich in vitamin C. The epidermis of the narwhal, the *mattaq*, which is used by the Eskimo as food, was found to be rich in vitamin C. In general, some of the internal organs (liver, brain, kidney, testicles, adrenals, thyroids, pancreas, lymph glands, etc.) of most arctic mammals proved to be excellent sources of vitamin C, as were the roe of salmon, and the brain, liver, and intestines of most arctic birds.

The author notes that some of these organs are not considered edible by the European trappers, while the Eskimo consume them all. This is probably the explanation for the fact that scurvy is unknown among the Eskimo of northeast Greenland, who must obtain all their vitamin C from the local flora and fauna, while cases of scurvy and other vitamin deficiency diseases have been reported among the white trappers even in recent years. In a dietary survey carried out among a group of Norwegian trappers the consumption of vitamin B_1 and vitamin C was found to be lower than accepted values for human requirements.

In his second paper Dr. Rodahl gives the results of an investigation of the toxicity of the polar bear liver. It has long been believed that illness follows the eating of polar bear liver. This belief, which is firmly established among the Eskimo, appears to be well founded. It seems, however, that certain livers are

[1]Rodahl, K., "Content of vitamin C (l-ascorbic acid) in arctic plants." *Trans. Bot. Soc. Edin.* Vol. 34, Pt. 1 (1944) pp. 205-10.

poisonous while others are not. Many explorers have experienced illness after eating polar bear liver, but a few have suffered no ill effects. The liver of the bearded seal was also found to be poisonous.

Prior to 1939 no attempt had been made to identify the substance responsible for the toxic effects of these livers. Certain symptoms which were reported by a number of explorers who had eaten polar bear liver, seemed to link the illness with a condition of hypervitaminosis A.

In 1939 Dr. Rodahl collected samples of polar bear livers in northeast Greenland which, when assayed, proved to be very rich in vitamin A (18,000 I.U. vitamin A per gram liver). Preliminary experiments carried out on rats fed with the liver indicated that the ill effects produced by the ingestion of polar bear liver were due to hypervitaminosis A. In 1947, during the Danish expedition to Peary Land, more samples were collected and again proved to be very rich in vitamin A (21,900 and 26,700 I.U. vitamin A per gram liver). Samples of bearded seal, arctic fox, walrus, and arctic hare livers were also assayed. The bearded seal and the arctic fox livers were found to be very rich in vitamin A (15,000 and 12,000 I.U. vitamin A per gram liver), while the walrus and arctic hare were relatively poor (1,200 I.U. vitamin A per gram liver). The Eskimo appear to recognize this difference as they eat the walrus and arctic hare livers but not those of the polar bear, bearded seal, and arctic fox. Dr. Rodahl's further experiments have shown that polar bear liver is toxic to rats (average: 0.5-0.7 gram liver per day corresponding to 13,350-18,690 I.U. vitamin A). The following symptoms were observed: reduced weight increase, haemorrhages, oedema of the palpebrae, soreness around the mouth, alopecia, limping, fractures, and death. Polar bear-liver oil in average daily doses of less than 30,000 I.U. vitamin A produced the same symptoms, but fat-free polar bear liver fed to rats caused no ill effect nor did vitamin A-free polar bear-liver oil. Rats given purified whale-liver oil (31,600 I.U. vitamin A per day) showed the same symptoms as those produced by the ingestion of polar bear-liver oil containing a similar quantity of vitamin A.

Dr. Rodahl concludes that polar bear liver is toxic to rats and that the toxic substance is vitamin A in excess, the illness produced being a condition of hypervitaminosis. He also showed that the symptoms in rats are proportional to the doses of vitamin A or the quantity of liver ingested. It is natural to assume that in the liver of bearded seal and arctic fox, known to be toxic and rich in vitamin A, the toxic factor is also vitamin A in excess. The absence of toxicity of certain livers found by some explorers, can be explained by the variation in vitamin A content of the liver, resulting from factors such as age and hibernating and feeding habits of the polar bear.

The condition of hypervitaminosis A has been known for 25 years but many aspects need further investigation. Dr. Rodahl reports the case of a man who ingested vitamin A in the form of halibut-liver oil. After smaller daily doses than may have been absorbed by explorers eating a meal of polar bear liver, he developed symptoms of the same kind. The studies on the toxicity of polar bear liver, which identified the toxic factor of the liver as vitamin A in excess, led to further work on the nature of the condition known as hypervitaminosis A. The results of these studies which are presented in his third paper are of interest to the physiologist and the nutritionist. Dr. Rodahl investigated in detail the following problems:

1) the possibility that toxic substances other than excess vitamin A were contained in liver oils
2) the influence of the method of administration of vitamin A
3) the effect of a massive single dose of vitamin A compared with the effect of prolonged administration of excessive amounts of vitamin A
4) the dose which produces toxic effects at different stages of development
5) the clinical manifestations and the pathological changes
6) the relation between hypervitaminosis A and the other vitamins.

The results of experiments have shown clearly that vitamin A is the toxic factor in the liver oils. Highly purified vitamin A given in excess produced the same symptoms on rats as vitamin A given in equivalent amounts in the form of whale-liver oil. Whale-liver oil in which vitamin A was destroyed caused no intoxication.

Oral, local, or subcutaneous administration of excessive amounts of vitamin A over a long period of time produced the same symptoms, although subcutaneous injection, due to a lower rate of absorption, produced the symptoms to a lesser degree.

Oral administration of a single massive dose produced acute intoxication with no detectable pathological changes and no lethal effect, while prolonged administration of the vitamin in excess produced a condition of hypervitaminosis A with clinical manifestations and pathological changes. The sex and age did not alter the symptoms, although the condition appeared later in older animals.

Doses over 50-100 I.U. vitamin A per gram body weight daily caused slight manifestations of hypervitaminosis A in rats. Doses between 200-500 I.U. vitamin A per gram body weight were particularly toxic while doses over 800 I.U. were lethal.

The acute intoxication produced by single massive doses of the vitamin was characterized by changes in the pelts, drowsiness, muscular weakness, and reduced activity. Chronic intoxication caused by prolonged administration of great quantities of vitamin A, produced symptoms similar to those of the rats fed 0.5-0.7 gram of bear liver per day. No pathological findings were significant except emaciation, arterial hyperemia, subcutaneous, muscular and visceral haemorrhages, thinning of the bone shaft which caused spontaneous fractures, enlarged adrenals, swelling of the visceral lymph glands, and fatty liver.

Additional vitamin B_1 had no influence on any of the symptoms of hypervitaminosis A. The condition of hypervitaminosis A did not prevent the development of rickets in rats fed a rachitic diet, though excessive doses of vitamin A proved to be more injurious to them than to normally fed rats. Hypervitaminosis A did not counteract the ricket-curing effect of vitamin D. Although in a condition of hypervitaminosis A the prothrombin time is prolonged, additional supply of vitamin K did not influence the appearance of haemorrhages or any of the other symptoms.

In the condition of hypervitaminosis A the liver and the serum had a very low ascorbic acid content. Large doses of vitamin C did not give any significant protection against the injurious effects of massive doses of vitamin A although the enlargement of the adrenals was prevented. However vitamin C had a beneficial effect against moderate excess of vitamin A. A great similarity exists between the symptoms of hypervitaminosis A as described above and the symptoms of scurvy. The complex clinical picture of hypervitaminosis A indicates an interrelation between vitamin A and vitamin C.

GUY MARIER

REVIEWS

A *MEGALONYX* TOOTH FROM THE NORTHWEST TERRITORIES, CANADA.

By CHESTER STOCK AND HORACE G. RICHARDS. *Science, Vol. 110, No. 2870 (December 1949) pp. 709-10; figure.*

POSTGLACIAL MARINE SUBMERGENCE OF ARCTIC NORTH AMERICA WITH SPECIAL REFERENCE TO THE MACKENZIE DELTA.

By HORACE G. RICHARDS. *Proc. Amer. Phil. Soc. Vol. 94, No. 1 (1950) pp. 31-7; illustrations and sketch-map.*

Both these papers record fossils found in the Northwest Territories.

"A *Megalonyx* tooth from the Northwest Territories" describes the discovery of the tooth of a ground sloth from the vicinity of Lower Carp Lake, north of Great Slave Lake. The ground sloths were a South American group that entered North America in Pliocene time, and left numerous remains in the Pleistocene of eastern and southwestern United States. They probably survived into post-Pleistocene time. This is the first record of a ground sloth from Canada, and is of special interest because of its subarctic occurrence. The authors note that a toe bone referred to *Megalonyx* had previously been found near Fairbanks, Alaska.

L. S. RUSSELL

In "Postglacial marine submergence of arctic North America" Dr. Richards gives a rambling summary of post-glacial marine submergence around the shores of North America north and west to Nome, and includes remarks on the migration of man and post-Pleistocene climatic changes of the Mackenzie Delta.

Dr. Richards' field work, made in the course of a brief visit to the Mackenzie Delta and Herschel Island, yielded some fossils and some notes on the formation of pingos.

As a whole the article lacks the true perspective which can only be obtained from a broad background knowledge of the region. This is also shown in the list of references which contains the titles of twenty-five papers but many giving a general background knowledge of the regions are lacking, such as the reports of the Geological Survey of Canada. The value of the paper lies in the lists of fossils collected.

H. S. BOSTOCK

NEW COMPASS OF THE WORLD: a symposium on political geography.

Edited by HANS W. WEIGERT, VILHJALMUR STEFANSSON, RICHARD EDES HARRISON. *New York: The Macmillan Company, 1949. 8½ x 5½ inches; xix + 375 pages; maps and diagrams. $5.50.*

This is a new work, although its title may confuse those who know of the earlier 'Compass of the world', published in 1944, by the same group of editors. 'New compass' is a symposium of twenty-three articles written by nineteen authors. The nature of the book can be judged from the titles of its five "chapters" into which the articles have been grouped: "The Arctic and Antarctic spheres"; "The heartland and the expansion of the U.S.S.R."; "New frontiers in central Europe"; "Strategic areas and life lines"; "Asia: one half of mankind."

Among its purposes, the book is intended to bring the reader "up to date on post-war developments in political geography". Some of the articles are reprinted, with revisions, from various journals in which they appeared as far back as 1946, but the majority are published here for the first time. Richard Edes Harrison adds greatly to the usefulness of the symposium by his admirable maps and diagrams.

Readers of *Arctic* may be particularly interested in the four sections of the first chapter: "The Soviet Union moves north" by V. Stefansson, "Canada's northward course" by Richard Finnie, "Canada: power vacuum, or pivot area?" by J. W. Watson, and "The Antarctic sphere of interest" by Lawrence Martin. Other articles having "high-latitude" interest include "Yakutia and the future of the north" by Owen Lattimore, and "The rail, water, and air transport system of the Soviet Union" by E. C. Ropes.

The first two sections–by Stefansson

and Finnie—content themselves with a brief statement of recent developments in the northern parts of the U.S.S.R. and Canada, supplemented by the fervent hope that the resources of arctic North America may be developed with the energy and enterprise shown on the other side of the polar basin.

J. W. Watson's article is a commentary on military geography with some reference to northern Canada. Much of it has no direct link with arctic affairs—the author discusses British-Canadian relations from the Sudan to Esquimalt, and not always with complete historical accuracy. When, for example, on page 46 he states that

> "In 1922 . . . British troops were involved in the war between Greece and Turkey . . . Canada refused to commit itself. . ."

he is less precise in his facts than a historian should be.

Only in the last two or three pages does the author deal directly with arctic Canada, and then he is inclined to give a military tinge to events which had other purposes. In writing

> ". . . it was announced in May, 1947, that nine joint bases would be established in the Arctic by the United States and Canada. While these are primarily weather and observation stations and civil air bases, they could easily be fitted out for military purposes. Canada has involved itself deeply in the protection of America."

he is giving an impression that is misleading. The stations referred to were of course *weather* stations, controlled by the weather bureaus of Canada and the United States. They were not in 1947, and are not now, "civil air bases"—and the depressing number of crashes at them by large aircraft gives ground for doubt as to whether anything can be done "easily" in such regions, even if it were to be attempted. Writers on military subjects have a special obligation to check their facts, knowing the unfriendly political ends to which their material may be put.

Those familiar with Colonel Lawrence Martin's writings on the Antarctic will need no hints from this reviewer as to the nature of his article. Although a part of it is titled "The political geography of the Antarctic" it is really a highly selective statement about some explorations of that region. In his efforts to claim territory for his native land, Colonel Martin is sometimes unintentionally amusing, as when he writes:

> "The young and competent discoverer of Antarctica revisited Marguerite Bay in November 1821. The United States settlement there at Stonington Island was reoccupied in 1947 by Commander Finn Ronne . . ."

He then continues

> "With these discoveries in the years from 1819 to the present century begins the public demonstration by the United States of America that we intend to settle and establish sovereignty in the portion of Antarctica south of Cape Horn, and probably in all other parts of the continent within the Western Hemisphere."

Fortunately for world sanity and friendly relations with other nations, "The United States of America" intends nothing of the sort if we may accept official statements from Washington. While Colonel Martin's section of 'New compass of the world' provides entertaining reading and a few incidental facts not previously published, it should not be taken either in North America or abroad as a serious statement of United States policies in the Antarctic.

TREVOR LLOYD

INSTITUTE NEWS

Research grants for 1952

The Arctic Institute is offering a number of research grants in 1952 for scientific investigations dealing with the arctic and subarctic regions. Research must include either field investigations in North America or studies at one of the Institute offices.

Applications for research grants will be considered from those who have demonstrated their ability to conduct research work of superior quality in some field of science. Preference will be given to residents of North America.

Completed applications must be received by 1 November 1951. The research grants will be awarded on the recommendation of the Board of Governors of the Arctic Institute, and will be announced not later than March 1952.

Application forms may be obtained upon request to: Research Committee, Arctic Institute of North America, 3485 University Street, Montreal, Canada, or Broadway at 156th Street, New York 32, U.S.A.

Award of Institute research grants

The following have been awarded grants by the Arctic Institute for field work in the 1951 season.

CAMPBELL, JOHN D., Department of Botany, McGill University, Montreal, Que., Canada.

A paleobotanical-stratigraphical study of the "muck" deposits of the Klondike district, Yukon Territory, to collect evidence on glacial and postglacial climatic sequences.

CROASDALE, HANNAH T., Department of Zoology, Dartmouth College, Hanover, N.H., U.S.A.

An ecological study of fresh water algae of arctic and subarctic Alaska, with particular reference to a comparison of glaciated and non-glaciated localities.

GUSTAFSON, FELIX G., Department of Botany, University of Michigan, Ann Arbor, Mich., U.S.A.

An analysis of representative plants from the vicinity of Point Barrow, Alaska, to determine their vitamin content, including ascorbic acid, thiamine, riboflavin, and niacin.

IRVING, WILLIAM, University of Alaska, College, Alaska.

An archaeological reconnaissance of the Brooks Range, Alaska, to locate archaeological sites containing implements of the Denbigh Flint Complex.

O'BRYAN, DERIC, Arctic, Desert and Tropic Information Center, Air University Library, Maxwell Air Force Base, Ala., U.S.A.

An archaeological study of Mill Island, Hudson Strait, including detailed excavation of a pure Dorset Culture Eskimo house site.

OSBORN, DALE J., Department of Zoology, McGill University, Montreal, Que., Canada.

An ecological and distributional study of selected vertebrates and invertebrates of Ungava-Labrador.

ROUSSEAU, JACQUES, Montreal Botanical Gardens, 4101 Sherbrooke Street E., Montreal, Que., Canada.

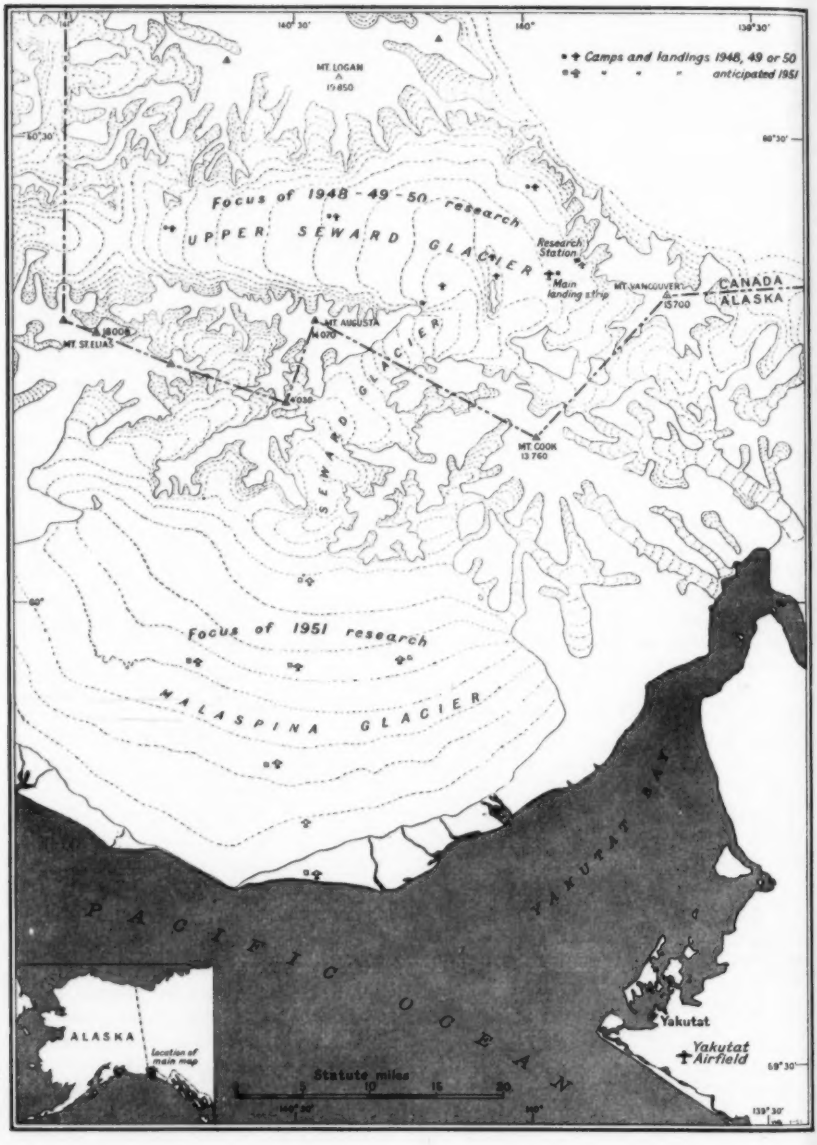
A botanical survey of Ungava-Labrador between the mouth of the Korok River and the Torngat Mountains.

STONE, KIRK H., Department of Geography, University of Wisconsin, Madison, Wis., U.S.A.

A geographical-geological study of Lake George and other ice-dammed lakes of Alaska to determine their physical characteristics and cultural significance.

Snow Cornice program for 1951

The Institute's Project Snow Cornice program of general scientific studies in the mountains of the southeastern Alaska-Yukon boundary region will be resumed in June 1951. As in 1948 and 1949 primary emphasis will be placed on investigations of the regimen, flowage, and structure of the Seward-Malaspina glacier system. Mr. Walter A. Wood, Director of the Institute's New York Office, will again lead the expedition, and Prof. Robert P. Sharp of the California Institute of Technology will again direct the glaciological program.



In earlier years investigations have concentrated on the high level area of snow accumulation comprising the Upper Seward Glacier (*see Arctic* Vol. 1 (1948) pp. 107-12 and Vol. 2 (1949) pp. 118-9). In 1951 it is planned to extend field studies to include the broad Malaspina piedmont sheet (approximately 1,500 square miles) which receives the discharge of Seward Glacier ice.

The Institute's Norseman aircraft, equipped with ski-wheels, which played

a vital part in Snow Cornice in 1948, 1949, and early 1950, and was also used on the Baffin Island Expedition led by Mr. P. D. Baird last year, will again be flown by Mr. Maurice King. The surface of the Malaspina Glacier is not suitable for landings by winged aircraft and 1951 operations below the firn line will be supported, and equipment and personnel carried to the area of study, by helicopter. A helicopter has been secured for the project by contract with the Lewis College of Science and Technology of Lockport, Illinois.

Twenty-three scientific investigators and their assistants, representing California Institute of Technology, the University of Minnesota, the U.S. Geological Survey, Toronto University, Haverford College, the American Alpine Club, and the Institute, will take part in the 1951 project. Field work will begin in June and the project will be terminated for this year on September 1.

Gifts and contributions to expedition expenses

The Chairman and Board of Governors most gratefully acknowledge the following gifts to the Library and Museum and contributions to expedition expenses:

Gifts to the Library and Museum

Books–Mrs. John W. Bell, Montreal; H. L. Eberts, Montreal; Major A. Taylor, Ottawa.

Maps–Hyacinth Lambart, Montreal.

Meteorological kite from Amundsen's *Maud* expedition–Department of Geology and Geography, University of British Columbia.

Propellor from first aircraft to fly in Hudson Strait-Baffin Island region, 1927–Charles Garnett, Edmonton.

Contributions to the Baffin Island project

M. H. W. Ritchie, Texas	$2,500.00
A. H. Campbell, Montreal	100.00
J. W. A. Hickson, Montreal	100.00
G. C. McDonald, Montreal	100.00

Contributions to the "Blue Dolphin" project

Arthur Dean, New York	$1,000.00
David Nutt, Etna, N.H.	1,000.00
L. H. Stubbs, Portland, Me.	600.00

John J. Teal

Carnegie Corporation	$5,000.00

NORTHERN NEWS

McGill University Geography Summer School

The following courses of special interest to students of the Arctic will be given at the McGill University Geography Summer School to be held at Stanstead College, Que., from July 2 to August 11. The arctic program will be directed by Mr. P. D. Baird, Director of the Montreal Office of the Arctic Institute.

Physical Geography of the Arctic. Lecturers: P. D. Baird, F. K. Hare, and Sir Hubert Wilkins.

Extent of the Arctic. The main physical features: climate, water bodies, ecology, snow and ice phenomena, landforms and terrestrial magnetism. Physical factors affecting human activity; living conditions; permafrost engineering; navigation; access by air. Main regional divisions of the Arctic.

Cultural and Political Geography of the Arctic. Lecturers: P. D. Baird, Sir Hubert Wilkins, et al.

Geographical regions and their characteristics. Exploration and discovery. National sovereignty and territorial claims. Native peoples, their origin, distribution, and activities. Economic

geography, including trading and transportation. Strategic considerations. Regional description.

Climatology. Lecturer: F. K. Hare.
Physical, dynamical, and ecological climatology, with special reference to the cool climates. Special emphasis will be laid upon (i) climatic classification; (ii) climate and vegetation, and (iii) climate and sea ice.

The Soviet Union. Lecturer: Bogdan Zaborski.
Territorial development of Tsarist Russia and of the U.S.S.R. Physical regions. Distribution of population, languages, and ethnic groups. Soviet agriculture and industry. Wartime and postwar changes in national economy.

Tuition for the six weeks' course $ 90.00
Board-residence for the six weeks 110.00

Further information concerning the School may be obtained from Professor F. K. Hare, Director Geography Summer School, McGill University, Montreal, Que., Canada.

The magnetite occurrence at Grönnedal in Arsuk Fjord, southwest Greenland

In the August 1950 number of *Arctic* (Vol. 3, No. 2) Dr. Richard Bøgvad described the magnetic iron ore deposit at Grønnedal in southwest Greenland and mentioned that diamond drilling to establish the extent and content of the deposit would begin in the summer of 1950. We have now received the following note from Dr. Bøgvad:

In the spring of 1950 the Cryolite Mine repaired roads and houses at Grønnedal after the havoc of the winter storms and the following thaw. The equipment was then transported from the coast up the mountain slopes to the magnetite occurrence, in which work the U.S. Naval Base rendered much assistance.

The Cryolite Company had engaged Svenska Diamantbergborrnings A/B to carry out a diamond drilling program proposed by the present writer, and work was started at the end of June. In the course of the summer six boreholes, totalling 750 metres in depth, were made at the most promising part of the magnetite occurrence.

The cores revealed that the deposit was smaller and of an inferior quality than had been expected from previous investigations. The geologists in the field estimated that up to a depth of 100 metres the tonnage of ore present would amount to about 1 million tons of ore only and that to obtain this it would be necessary to blast a corresponding quantity of country rock.

When the core samples had been analysed for iron, phosphorus, and sulphur, all results of the investigations were given to two Swedish mining experts, who independently arrived at nearly the same conclusion: up to 50 metres in depth 800,000 tons of ore containing 25-30 per cent of iron had been found. They considered that mining the deposit would not be an economic proposition and that further prospecting could not be justified.

In accordance with these views the technical investigations of the iron ore deposit at Grønnedal have been terminated and all that now remains is to complete the scientific study of the rocks belonging to this unique geological formation which includes nepheline syenite, diabase, and essexite together with magnetite, hematite, siderite, and calcite.

The 1950 Eastern Arctic Patrol[1]

The 1950 Canadian Eastern Arctic Patrol, the twenty-eighth since the Patrol was inaugurated, marked the maiden voyage of the *C. D. Howe*, the new 3,600-ton Department of Transport vessel.[2]

The *C. D. Howe* sailed from Montreal on July 17 with Captain A. Chouinard in command, and returned to Quebec on September 22. The vessel called at Cape Harrison, Port Burwell, Fort Chimo, Churchill, Cape Dorset, Lake Harbour, Pangnirtung, Clyde, Pond

[1]Reprinted in the main from the *Arctic Circular*, Vol. 3, No. 6 (1950) p. 70.

[2]For descriptions of this vessel see *Arctic*, Vol. 1, No. 2 (1948) p. 121 and Vol. 2, No. 3 (1949) p. 200.

Inlet, Arctic Bay, and Dundas Harbour, the most northerly place reached, and at Frobisher Bay on the way back to Quebec. Using the helicopter members of the Patrol also visited Makkovik from Cape Harrison, Labrador, and George River while the ship was in Ungava Bay. Unfortunately the helicopter was lost off Fort Chimo on August 5, causing the death of Sam Ford, official Eskimo interpreter on the Patrol. Craig Harbour was not reached this year owing to lack of time. It had been planned that the R.C.M.P. detachment at Dundas Harbour was to be taken north to reopen the post at Craig Harbour, but this move had to be postponed.

Fort Chimo has not usually been visited on the Patrol, but this year freight was brought in for the weather and ionospheric stations. The freight for Port Harrison, Cape Smith, and Sugluk, normally carried by the Patrol, was handled by the Hudson's Bay Company's ship *Rupertsland* and the Roman Catholic Mission ship *Regina Polaris*, both of which were in the Bay during the summer.

In recent years the scope of the Patrol has been enlarged as a result of the increased activity in the north. It is now a combined effort of six government departments: Resources and Development, National Health and Welfare, Transport, Mines and Technical Surveys, Justice, and Post Office.

The Officer in Charge of this year's Patrol was Mr. A. Stevenson of the Arctic Division, Department of Resources and Development. He was assisted by Mr. R. G. Johnston of the same Department whose duties were chiefly statistical in connection with family allowances, relief, decennial census, vital statistics, and old age allowances for the Eskimo.

Members of the Patrol organized plans for taking the 1951 decennial census in the Arctic. Making accurate returns for the 8,000-odd Eskimo scattered over the Arctic will be one of the most difficult census assignments in Canada. It will be carried out by the R.C.M.P. and must be completed by shiptime next summer.

At each port of call the senior medical officer, Dr. J. C. Osborne of Edmonton, examined the Eskimo. Dr. Osborne was assisted by F/L J. R. Wynne and Nursing Sister M. P. Brown of the R.C.A.F. who joined the ship at Churchill. The general standard of health of the Eskimo appeared to be good and over a thousand were X-rayed. Eighteen sick Eskimo, mostly suffering from tuberculosis, were moved to Pangnirtung Hospital or outside hospitals for further medical treatment. Dr. R. S. Robertson, a dentist from Cobourg, Ontario, was kept busy checking, extracting, and filling the teeth of both whites and Eskimo.

Mr. R. A. Hadden of Ottawa, was in charge of postal service. He noted a marked increase in the use being made of the mails by the Eskimo, who communicate with each other by syllabic script which nearly all can read and write.

Among the passengers picked up or dropped along the route were the Right Reverend D. B. Marsh, Anglican Bishop of the Arctic, several Oblate missionaries, Mr. J. W. Anderson and other officials of the Hudson's Bay Company, Inspector Henry Larsen and Staff Sergeant W. C. Dodsworth of the R.C.M.P., and Dr. J. H. Nesbitt. At Clyde fourteen members of Mr. P. D. Baird's expedition were taken on board, after having spent three and a half months in the Clyde area.

Weather conditions were exceptionally good and only loose ice was encountered in Lancaster Strait and Admiralty Inlet.

A. STEVENSON

Auroral observations in the Barents Sea, 1949

According to a report published in *Polarforschung* (Bd. 2, Heft. 1/2 (1950) p. 285-6), Dr. Werner Sandner accompanied the fishing vessel *Berlin* of Hochseefischerei-Gesellschaft "Nordsee" (Bremerhaven) on a cruise to the Barents Sea in November and December 1949. His object was to study northern lights and haloes in that area.

The *Berlin* left Bremerhaven on November 18, was off Nordkapp (North Cape) on November 23, and on reach-

ing the Barents Sea cruised in the area round lat. 71°N., long. 41°E. The homeward voyage began early in December: Nordkapp was passed on the 4th and Bremerhaven reached on the 11th.

The weather was favourable and northern lights were seen on November 21, 22, 24, 26, 28, and 29, and again on December 6. Few haloes occurred because the sun was already below the horizon and the moon was not full until December 5, when the *Berlin* was homeward-bound. However, lunar haloes were observed on December 6-7, from 15.00 to 08.00 hr., in about lat. 70°N., and again on December 11, from 06.00 to 08.00 hr., at Bremerhaven. A solar halo occurred on December 10, from 11.00 to 13.00 hr., when the vessel was passing through the North Sea.

Wind and temperature measurements were recorded throughout the voyage.

CORRESPONDENCE

BARTLETT MEMORIAL FUND

To the Editor:

The Explorers Club is inviting contributions to a fund in memory of Captain Robert A. Bartlett whose name for so long has been associated with Arctic exploration.

In view of the many years that Captain Bob devoted to schooling young men in the lore of the Arctic and stimulating their interest in exploration in the North, it seemed fitting to establish a Robert A. Bartlett Scholarship at the Memorial University College in St. John's, Newfoundland, so near to Brigus.

It is hoped that all friends of Captain Bob and others interested in exploration will contribute to this project. Cheques should be made payable to The Explorers Club, earmarked for the Bartlett Memorial Fund, and mailed to 10 West 72nd Street, New York City. We have been advised that United States citizens may deduct such contributions from their income tax.

Very truly yours,
Bartlett Memorial Fund Committee

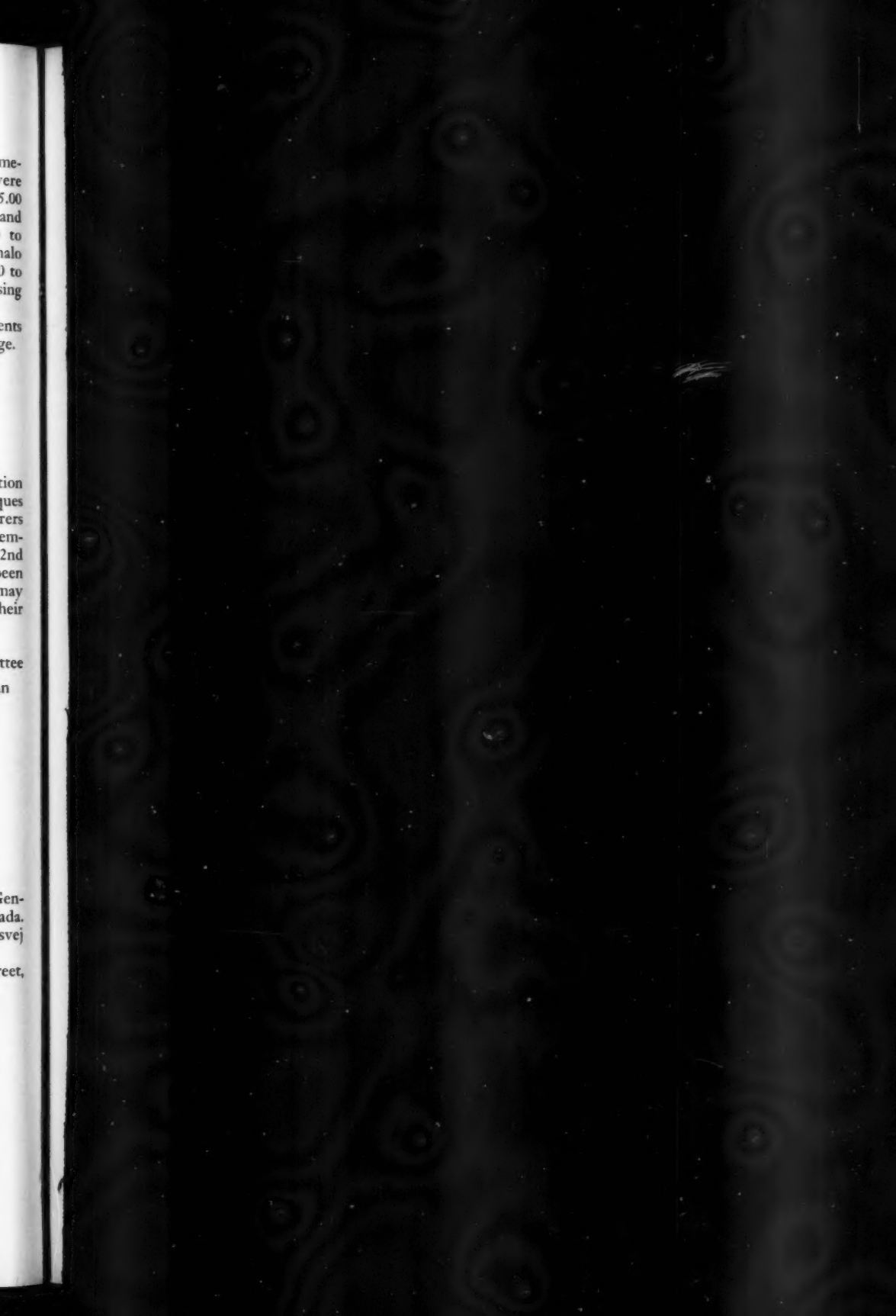
William K. Carpenter, Chairman
Amos Burg
John H. Foster
E. Irving Huntington
Alexander Wetmore

ELECTION OF FELLOWS

At the meeting of the Executive Committee held in Washington on 19 December 1950 the following were elected Fellows of the Institute:

Dr. C. Earl Albrecht, Department of Health, Juneau, Alaska.

Dr. G. Malcolm Brown, Kingston General Hospital, Kingston, Ont., Canada.

Dr. S. Richard E. Bøgvad, Grøndalsvej 42, Copenhagen, Denmark.

Joseph T. Flakne, 3039 Macomb Street, Washington, D.C., U.S.A.